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ABSTRACT

Prepared for use in outdoor and environmental studies, this manual provides a collection of activities which focus on awareness, represented as a process involving observation, interpretation, and application. Traditional subjects and processes are suggested for each component of the awareness continuum. However, because the activities are non-graded, teachers are encouraged to synthesize the ideas with the awareness continuum in a manner best suited to individual needs and interests. The activities, ranging from environmental collages, language arts in a sandbox, and weather forecasting to community structure analysis, forest management, and blind nature walks, can be used with pre-schoolers through adults. Materials needed, objectives, and procedures are outlined for each activity. In addition, the handbook discusses planning an outdoor education area, pre- and posttest ideas, guidelines for environmental action, community resources, and compiles data charts, diagrams, and bibliographic references. (BL)

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OUR WORLD AND WELCOME TO IT:

A HANDBOOK FOR ENVIRONMENTAL EDUCATION

By

Jack A. Seilheimer

Ed Lane

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Man and Environment

The age of Technology arrived and Man said, "It is good! Now I am Master of the environment. I have created machines to do my work, and to change and control my world. I have stripped the earth to fill my needs and wants". And Man looked at the monotony and spoil He left behind Him in the pathway of Progress and said, "It is good!"

Man now sensed a need to pass on His ideas to His children, so he built Schools and made Reading the god of all Schools and Books the tools of worship and said, "My children must learn symbols for things and how to read. They must learn to use the comma and to diagram sentences and then, if I have time, I will teach my children how to live." Man's children did learn to read and Man said, "It is good! Now my children must learn to read by age six and I must find more symbols for them to learn." And so Man taught His children to read by age six and any child of Man who did not learn to read was deemed a failure. Great and wonderful Books were written to explain how and why children fail, and new Books and Machines were made, at great expense, to make sure the children of Man would not fail again.

And then Man said, "My children must have fun and affection." So He created a great variety of toys and made pets of all kinds of animals. And Man said, "It is good!"

Then Man said, "I must have even bigger and better Machines to do my work and thinking." So the Machine became god of Man's world and home. And Man knelt and prayed, "Dear Machine-god, anything I can do, you can do better. I thank you for my automatic transmission, my electric comb, dishwasher, toothbrush, ham-slicer and can-opener, my riding lawnmower, and my bicycle exerciser. Amen."

The Machine-god left Man free to play with politics and war, and to build even more Machines which could create, extend and destroy life. Nothing seemed beyond Man's reach and control. He was creator and Master of His world and He filled His house with children.

Then one day Man opened his eyes and asked, "Have you noticed the sky isn't blue and the waters aren't pure anymore? Where are the beasts and flowers of the field I knew in my childhood? What happened to the beauty of the earth? Why are my children so unhappy?"

And the great Environment replied, "Foolish little Man. You have lived without wisdom or thought of tomorrow. Your children read but they do not see, they listen but they do not hear, they know but they do not understand.

Tell me little Man, when your children cry out for food will you give them another book to read, when their mouths are cracked with thirst will you provide a better car and when they choke for air to breathe will you promise them better jobs?

I am not your servant Little man I am your judge and jury and the keeper of the laws.

Before Man came the Natural laws and unless you learn to live within these laws all your wars, inventions and progress will have been for nothing for you will burn up in the energy you release and bury yourself in your own waste.

Your children will be punished in the courts of Environmental Justice and who will hear their cries in the empty naked land?

And then Man said nothing and went up on a mountain top to think on these things.

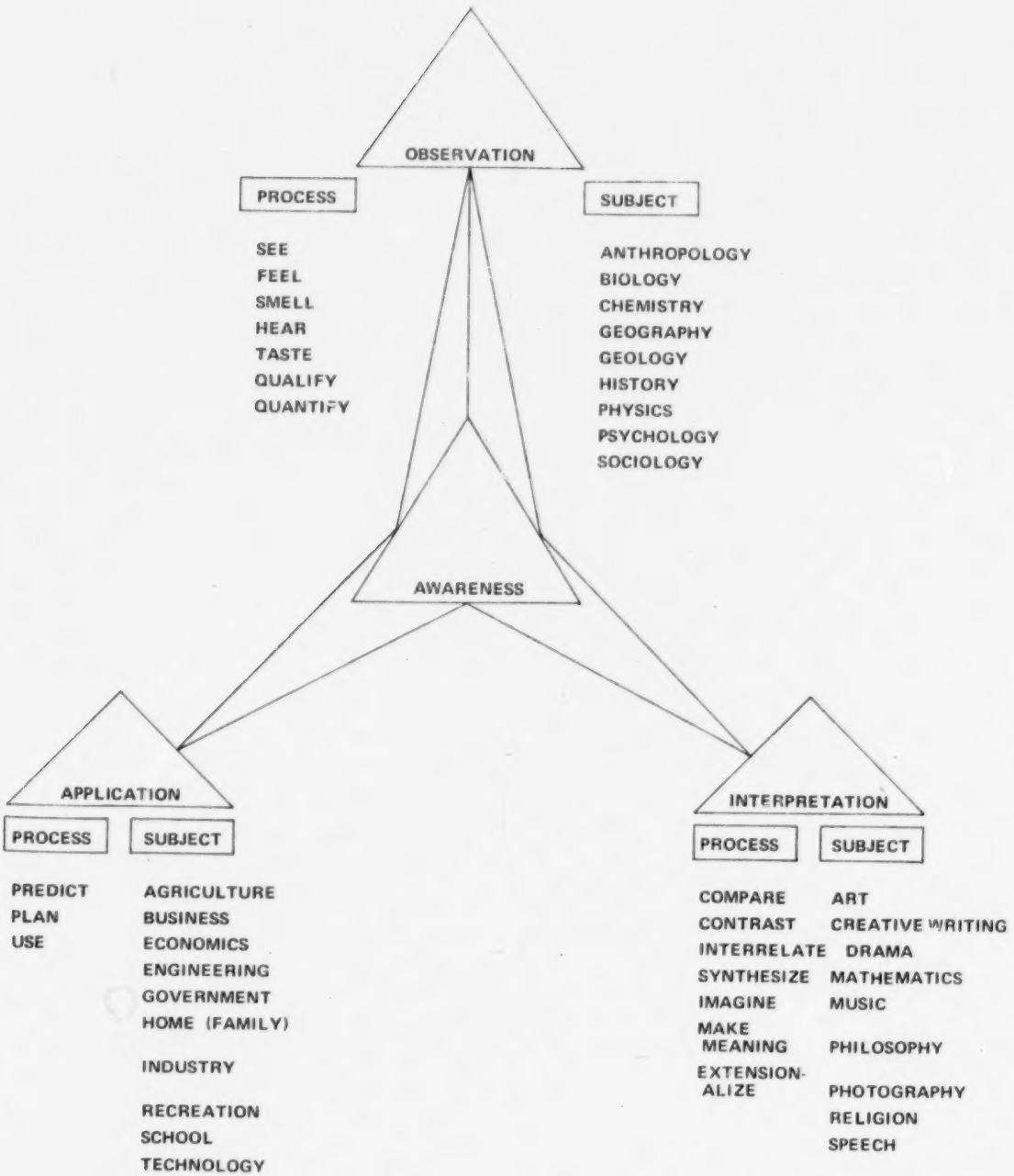
HOW TO USE THIS MANUAL

The loose-leaf notebook and non-graded format for this manual has been developed to permit easy removal and rearrangement of sections, exercises and pages in order to meet your individual needs and to facilitate the inclusion of additional information, personal notes, lesson plans, magazine and newspaper articles, etc. Flexibility is very important and we hope the loose-leaf and non-graded ideas will encourage and facilitate the kind of individuality and freedom needed for the implementation and expansion of your program.

Study the "Awareness Continuum" diagram which follows. You will notice that awareness is represented as a process involving observation, interpretation and application. Traditional subjects and processes involved are included. We suggest that you use your creative ability in each environmental experience you provide for your students. Use our ideas as "triggers" or beginning points and then plug into and follow the "Awareness Continuum" as far as time, energy and interest justify.

Good luck and welcome to the world of environmental change!

AWARENESS CONTINUUM



PLANNING THE OUTDOOR EDUCATION AREA

The outdoor classroom serves several purposes: ecological improvement, education of the citizenry to the needs and understanding of natural phenomena (especially training school age children how to utilize sensory development for understanding and appreciation of environment), and development of an understanding of the beauty of nature. Perhaps we should indicate that development of a personality towards one's environment is important.

Children generally do not learn how to appreciate the habitat, due to lack of motivation, experiences, or general knowledge. Skills must be introduced and developed for subscribing toward a healthy attitude--the beauty and knowledge, to a great extent, lie in your hands.

An area next to a pre-school will differ from that near a nursing home, one used to reclaim a hilly area will differ from that which stops a flat playground from blowing away.

First, decide on the needs of the area to be designed. Does it need a windbreak, shade, beautification, erosion control? What are the soil conditions, the availability of water? Establish traffic patterns, consider the general community use and make provisions for the handicapped. Make use of already available growth, or natural land contours.

Look at your local park area. Is there something that should be added to make that a more interesting, more inviting place for learning? And that beauty spot downtown, is there any good reason why a sturdy sundial, weather instruments, and rainfall or pollution gauges cannot be placed here and there for the enjoyment and interest of passers-by? If trees are planted, can some type of identification plate or information plate accompany the plantings? Can trails for the blind or wheel chair paths be added to the park for the handicapped? Can an unused corner of a parking lot be turned into a mini-education center with information tables about rocks, plantings or local history?

Can spots be located here and there along bike or horse trails to increase man's knowledge and appreciation of his environment?

BUILDING AN OUTDOOR EDUCATION CENTER

After the plans are made, how do you begin? Where will the funds and the labor come from? Who will organize and get things moving?

First of all look to the community: the local school community and the larger city community. Every community has people of many talents, garden clubs, cement and rock workers, landscapers, the man or the woman in the neighborhood with the green thumb and the willing heart, the rockhounds, the environmental hobbyists, the men and boys with the trucks, shovels and helping muscles.

A school organization such as the P.T.A. or P.T.O. can be very valuable. Civic clubs, soil conservation people, regional planning developers, beautiful associations, expertise hired by the city such as manager of the parks department, science organizations, and school clubs such as the student council.

Types of activities offered by the P.T.A. or other parent group working with the school:

1. Bake sales
2. Fashion shows
3. Carnivals
4. Donation collections
5. Preparing meals
6. Helping plant plants
7. Contacting local officials such as councilmen, city manager, etc. for support
8. General support

Teachers, and especially the principal, need to work very closely with the community toward project development. The school is an integral part of the coummunity and needs to be looked at as a place that helps stimulate thought and work towards the betterment and understanding of the area.

The school student council can be helpful by:

1. Helping with the labor - involvement is crucial - students will support, and take much better care of the area if they are directly involved with the planning and building. An involved school is healthy.
2. Candy sales - sponsoring.
3. Contests - sponsoring such as collecting paper, and aluminum for raising funds and emphasizing recycling.
4. Sponsoring pay films.
5. Clean-up campaigns, writing government officials, inviting guest speakers, poster contests, obtaining information on current issues regarding the environment, and obtaining current information regaring current legislation.
6. Pop bottle collections.

WHEN DO YOU BEGIN USING THE CENTER?

Actually, though the trees may not be grown for 30 years, nor all phases of the center completed for 10 years, perhaps the most learning takes place during the planning and building stages. As you investigate and explore the possibilities, you may very well be taking your first close look at environment as a whole. As you dig, plant, make, build, and create, you may learn things you have never been aware of about climate control, soil conditions, density of grass due to amount of water, differences in plant growth, problems of care and needs of plants, relationships of living things to one's environment, crowding conditions, symmetry and beauty of nature.

Always keep in mind that much knowledge can be gained from the student. It is your function to guide and disseminate information at the proper time. Guide the student towards a higher level by allowing them the opportunity to question, think, listen, and create. They can be invaluable when it comes to creative thinking and designing activities that you or I have never considered. You may feel uncomfortable about using the center. Don't - take your students out for a look; let them sit around and relax; let them browse through the different regions, let them compare, investigate, and develop an interest in the area. They will begin to ask questions; talk about what they see, and discuss differences, etc. This is what you want - many fine activities will come out of an informal approach. Once you begin using the outdoor classroom, you will never regret your move.

One more thing--don't wait until it's warm before you commence using the area. Take a look each week or two - you may begin to use an excellent scientific approach without knowing it - comparisons can be made over a period of time as to changes that take place. Records can be kept of changes due to climatic conditions.

The school can be very helpful by giving this type of project its fullest support. Make students aware of environmental problems by encouraging teachers to incorporate environmental study as an important part of the curriculm; by celebrating Arbor Day; by encouraging students to participate in clean-up signs; by collecting aluminum for recycling; and by encouraging setting up specific days, weeks, months, for environmental projects. Staff can and should participate in the planting of plants, designing of the projects, and encouraging of the community to become involved during conferences, informal visitations, and school-community functions.

Younger Children

Many children going through our elementary schools have not developed their senses adequately. It is strongly urged that many activities be centered around sensory development.

A 20 question game can be established for the students. Questions can be developed by students or teachers.

SIGHT

Observe shapes and sizes of trees. Make comparisons - larger, bigger, smaller, fatter, etc.

Observe colors and variations in color due to climatic change, due to disease, etc.

Keep a record of color change by painting, coloring, using colored sand etc.

HEARING

Listen to sounds in the center. This would be primarily animal and weather sounds. The larger neighborhood environment may offer additional sounds such as automobile, telephones, and emergency noises such as sirens. The instructor may tape outdoor noises for discussion and identification.

TOUCH

Have students feel different types of soil, such as sandy, clay, potted soil for planting purposes, and regular dirt from someone's backyard. Allow the students opportunities for discussion of differences.

The same kind of activity can be accomplished by using leaves, twigs, grass, and other objects obtained from the center.

Refer to the area concerning the sandbox for other recommended activities dealing with feel.

SMELL

Students can spend quite a bit of time smelling different odors from the center. This can occur when budding commences and when flowers are developing.

TASTE

Tasting activities must be observed and studied very closely. Precautions must be made and students indoctrinated thoroughly concerning placing unknown items in their mouths.

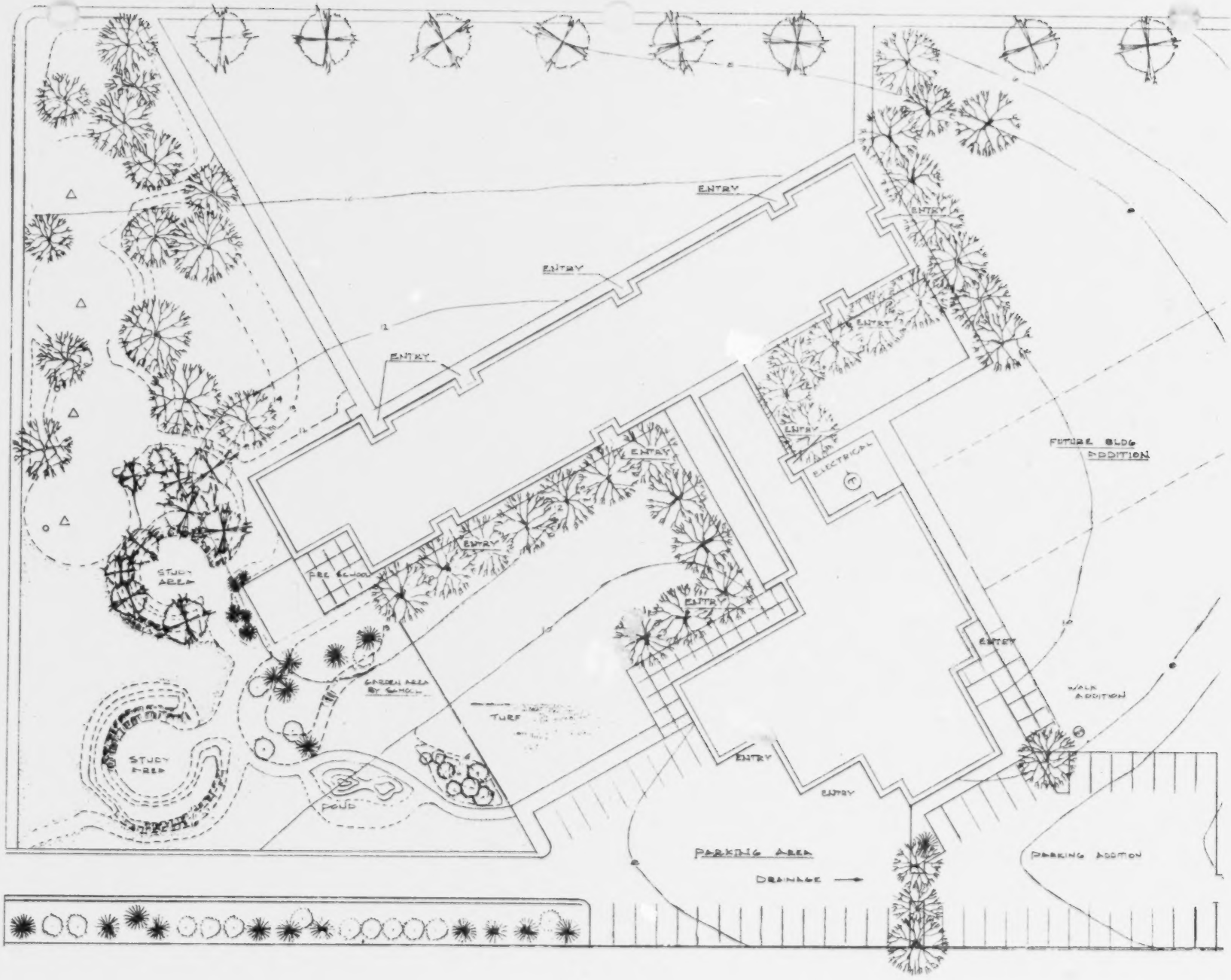
Controlled related activities can be introduced to increase skills with this sense.

Regional Centers

Students can develop a great deal of interest in the environment by establishing centers, in the outdoor classroom, that feature native plants and the type of area in which they are located.

Regional Center - Take the state you live in and try to develop a small center that has native plants familiar to that region. Mountainous, River Bottom, "Temperate" or Foothills, and Semi-arid and Arid regions. It is a little more difficult to construct using native plants, because of the problems facing you in collecting specimens. However, the students should find this very valuable for studying the history and becoming more aware of the types of trees, shrubs, grass, and flowers native to their state. The students gain a great deal of knowledge helping set up these areas, using research skills, reading, language, etc. - checking with local resource people and pet shops for additional information.

One area should be set aside to plant anything that you want to plant, regardless if it is native or not. Some plants should be selected on the basis of attraction and benefits to insects and other types of animals. Perhaps a rotting log might be beneficial, a bird house or two, and what's wrong with a bee hive? Ants should be introduced if they do not find their way; however, you surely won't have much of a problem with that. This is the area in which you place plants that are unfamiliar; or you can get involved with transplanting plants commenced in the classroom, planting roses or other kinds of flowers found in nurseries.



SOUTH PARK SCHOOL

NOW WHAT?

Non-graded Activities
Pre-school through adult

NON-GRADED ACTIVITIES FOR THE OUTDOOR CENTER AND RELATED ACTIVITIES THAT CAN BE UTILIZED IN THE CLASSROOM

It must be noted that the following activities are non-graded, awareness and involvement centered, and can be adapted. It is recommended that the teacher use these activities as ideas for commencing projects and for becoming involved with the environment.

Children must be given every opportunity to develop the senses. This has been a general weakness in the educational picture, and this weakness can be rectified. Work with basic activities that will allow students the opportunity to utilize all senses and then gradually increase the difficulty of assignment to further develop and enrich experiences.

An awareness test can be given to each class to determine possible strengths and weakenesses that individual students might have. Many activities might be set up for individual students to strengthen particular weaknesses that he or she might have. Individual projects may also be given to students that catch on quickly or need enrichment activities. Here is an excellent opportunity to capitalize on interests of students. What better way can be found to motivate and develop skills for students that show interest in a certain project or particular interest? This is very good for school-community relations and an excellent way to commence a parent-teacher conference.

Environmental Awareness
PRE- and POST-TEST Ideas

Use the information gained to help you plan activities.

Awareness Testing

(1) Put your hand up if what I say is right - Put your hand down if I am wrong.

Make statements such as:

A worm has 6 legs.
There was a puddle on the playground this morning.
The wind was blowing on your way to school.
There is grass by the sidewalk.
There were marks on the sidewalk.
Trash was in the hall.

Choose items that children should have been aware of.

(2) For children who can draw or write.

Draw three animal signs you saw on the way to school this morning.
Color the sky as you saw it this morning.
Draw a picture of the tree that is in your neighbor's yard.
Name four outdoor sounds you heard this morning.
How many animals did you see on your way to school?
Draw pictures of birds you saw coming to school. Color the bird.

(3) For older students.

When was the last time your neighbor cut his lawn?
If we have a heavy rain, which direction will the water run off in the street in front of your house?
Which way was the weather vane turning?
If you have a pet at home, what color eyes does it have?
How many airplanes do you hear per day?
What color were the flowers you saw on your way to school?

(4) Developing the concept of environment.

Let students discuss what they think environment means. You may have to discuss things with which they are familiar, such as your classroom environment, home environment, the bedroom environment, a restaurant environment, park, neighborhood, etc. After this discussion, students should have a better understanding of an environment and its relationship to man. Topics such as beautification, pollution, etc. should be emphasized.

After the discussion and a development of the environmental concept, have students, who are able, write a description of their environment as they see it. This is an excellent post test - keep the results and present the same test at a later date for determination of changes that may have taken place.

Use words from the list below or add words that you are familiar with and that are not included.

Describe your environment

change	open dump	distasteful	life
pretty	dull	death	graceful
dust	beauty	clean	joy
horrid	dust	ecstasy	terrible
windy	enjoy	personality	stale
enthusiastic	good manners	litter	erosion
fertilizers	feelings	city	vandalism
insecticides	Fed. Government	aesthetic	good smell
beautiful	variety	poison	warm
ugly	carbon monoxide	graceful	incineration
great	smell	offensive odors	good
harsh	cartons	restore	offensive
cans	decay	pure	paper
bad	wet	trash	

Students having a difficult time with writing a description may use a tape recorder for the description, or the individual may describe the environment using an art project by cutting pictures from magazines, etc. Emphasize creativity in the description: poetry, writing a story using characters, read a book about an environment similar to yours, or perhaps a group of students can create a mural about their neighborhood environment.

(5) Treasure Hunt - Give children a list of 10-20 items to look for and send out to collect.

Three signs of animal life.
Two pebbles that appear to be stream washed.
One sedimentary rock.
Three seeds.
One leaf from a deciduous plant.
A natural material that can be used for building.
Two dead branches showing different leaf arrangements.
A rock that has attracted your attention.
Two different kinds of animals (insects).

HALL BEAUTIFICATION AND INDOOR STUDY ACTIVITIES

Environmental study does not need to stop in areas where cold winter weather discourages much work out of doors.

Some plants that do not winter well can be potted and distributed to classrooms for winter care. Bulbs can be dug up, studied, and stored to be started in early spring. Seeds from trees and flowers and weeds can be collected when dry and planted in classroom windows for closer observation of plant growth.

Small outdoor animals such as horned toads, lizards, field mice, etc. may be collected and kept in terrariums to be turned loose in the spring. Cocoons may be collected for study; fallen bird nests may be brought in. Seed pods, dried weeds, or leaves can be collected for study and art projects. Early in the spring plants may be started in window boxes in the classroom for transplanting when the weather is warm enough.

Hall Beautification

Establish a large fish tank in the hall. This creates a tremendous amount of interest and enthusiasm of the entire student body. They can help by bringing fish, purchasing food, and cleaning and taking care of the tank. The tank can be used for observing and comparing changes that develop within the habitat. Population can be studied by density of animals in relation to size of the tank. Records can be kept of fish growth, fish can be named, contests can be set up by determing size and growth gained, etc. Games can be set up by classes or individuals guessing number of fish in the tank.

There is no reason why plants cannot be grown inside the building. Why only establish an outdoor classroom? The hallway can be beautified with plants that are conducive to growing indoors. This also gives the students excellent opportunities to learn more about taking care of plants and gaining a better understanding of a different type of plant and different needs. Each room can have the responsibility of taking care of a certain number of plants. This gives students added interest and responsibility. Growth rates can be compared, and further research can be accomplished by interested students.

A large cage or a multicage affair can be established in the hallway; again, students can take turns taking care of the animals. Sometimes pet stores will lend unusual animals to the school for a week or two. This maintains interest in and an understanding of different types of animals.

Along with traditional pictures such as George Washington, Abraham Lincoln, etc. large pictures concerning the beauty of the environment should be hung and changed periodically. Students' paintings, drawings, and other art objects should be displayed in the hall.

A large map of the school can be placed on the wall for addition of trees, plants or other objects added, and date of addition can be recorded. If the school has a long range blueprint for development, the map can be put up with additions marked to be colored in at time of addition.

Activities

Many activities will develop as the center progresses. Transplanting, purchasing, and determining where plants will be located will create problems and experiences that will be very meaningful to the students and adults in charge. Soil condition, temperature, moisture, and locating proper plants will play a very important role in the success or failure of the project. Research skills, obtaining resource people, discussing, and actually doing the work will enhance the value of the center.

1. What size of plant is best for transplanting?
2. Can native wildflower seed be purchased and what is the best procedure for allowing seeds to develop?
3. When is the best time for transplanting?
4. What resource people are available?
5. Should plants be transplanted right away?
6. What are some methods that might be used for involving the community?

Students should be directly involved in contouring, leveling, planting, weeding, etc. It has been found that the general community has a stronger feeling towards the center, and the children will show greater respect for the entire area when actively involved.

Students can develop keys for identification purposes: A map showing where the plants are located and what they are--help may be obtained from an individual who knows plants well; perhaps a picture key can be developed for helping to identify trees, animals, and smaller plants; pictures obtained from books, magazines, advertisements concerning plants, and other material may be collected for this activity.

Pictures can be taken of individual plants. Slides can be developed for further research and identification purposes.

Develop a benchmark indicating elevation, latitude, longitude, section, township, etc. Add a sundial and a large compass for establishing other kinds of problems and activities.

Use the Outdoor Center for role playing prior to writing a story, a play, or other literature.

Students can become quite involved with mathematics by scaling size and center, trees, and placing information on maps that can also be developed by the students. Weight problems (with rock comparisons), area problems, studying perimeter, circumferences, using angles for measuring purposes, using circles, squares, and rectangles for identification of an area to study, using estimation principles by stepping off distances, estimating number of plants, establishing contests concerning number of items in an area, collecting and organizing data, using sampling techniques, and doing a large amount of graphing growth changes. Adding problems can be set up, subtraction can be established when there are losses in the center, ant population can be estimated, numbers of animals during a certain climatic time, estimation of density of grass due to amount of moisture - setting up problems allowing some areas to receive more water for helping to determine density.

Observe drainage and run off problems using water and study methods by which erosion rate can be reduced.

Students can take samples of the soil and have it tested by a soil conservationist or perhaps a testing kit can be ordered and students can do this activity themselves. This might give you some idea of the type of soil and what kinds of plants can be introduced. Different type of soil can be brought in to further enrich the center for growing additional types of plants. What's alive in the soil? Students can probe the soil for signs of life. Will life appear if the soil becomes richer?

Build replicas of mines and mining settlements.

Collect most common or most prized Colorado or other native state minerals. Identify and cement into place for further study.

Students can have fun locating shadows. They can play shadow tag, measure their shadows, and attempt to determine where their shadow will be.

Animals

Keep a record of smaller animals by photography, collecting specimens and studying in the classroom, through art, and other techniques. Study their habits (feeding, movement, paths, home environment, and how they track animals and carry to their home). This is an excellent independent project. The student can record through story, (or whatever methods he chooses); research techniques should be used for finding additional information about the animal.

Observe different kinds of animals that may be found in your center. They will generally find ants, small bugs, perhaps bees, butterflies, moths, worms, and birds. They can cut pictures out of magazines, draw, paint, describe on tape, discuss, and use their creative skills as much as possible for recording what they saw. Many fine creations can be developed using art activities.

Keep a record of kinds of animals that are drawn to the habitat and study why animals are there during a certain period of time. Examples: when flowers bloom for individual kinds of plants; when there is more moisture; when nests are observed, or when plant odors are more pronounced.

Have the students become familiar with the term habitat and begin to observe different habitats within the community. It may be the total neighborhood, or only the semi-arid region. Develop a habitat chart - What animals live in a particular habitat? Collect pictures appropriate for that habitat.

Look at tracks and try to establish what kind of an animal made the tracks. Remember Man is an animal. Walk out after snows, rain, windstorms, on days that are extremely hot, and compare differences that they have seen. Ideas such as puddles, mud, deep or shallow snow, branches blown down, plants destroyed, plants turning color due to heat, may be brought out and discussed. Again, it is important for students to have the opportunity to bring out their ideas.

Keep a record of tracks (animal) by plaster casts. Compare number of tracks by available water and other areas of the center. Check from time to time to determine if population of animals is increasing or decreasing in number.

Observe changes that may be taking place in the center such as additional ant hills showing up, more bees being attracted to the center, additional birds coming in for food, the addition and height of weeds, and the adding of more plants, trees, rock, and expansion of the center.

Animal habitats may be introduced for all ages. The kind of activity may vary, but it is important for individual environments to be commenced. For example, introduce a lizard into the classroom. What kinds of food does he eat? What plants can you place in the terrarium that are native to that particular lizard. Observe changes that develop within the habitat. You can mark individual lizards with different kinds of fingernail polish for identification purposes, if there are more than a couple of lizards in the tank.

Establish small animal centers. Use insect cages and other containers for observing small animals collected from your center.

Other animals you might study are: Mealworms, pillbugs, snails of different types, common non poisonous snakes, tadpoles, turtles, mice, gerbils, rabbits, and other animals that are easily obtained and not too expensive. There are many fine books written about animals in the classroom.

Develop pond life tanks in your room. Algae and other microscopic animals may be obtained from your pond or from the marsh area. If one is not available, locate a pond for obtaining specimens. Older students can gain much sophistication with microscopes and stereoscopic scopes studying pond life. This is an excellent activity for studying habitats and how they change.

The same kind of activities can be accomplished with aquaria: students can become involved with population problems, or pollution problems due to overfeeding or perhaps too many plants in the tank.

Where did the water go when you made your lake?

Are you really going to build a road through your house; why?

Which one of the cups holds more sand?

Use for family role play - fathers place of work, how he gets there, where mother shops, and so forth.

Build more complex communities using milk cartons, houses, develop businesses, and study community helpers needed to serve a community and the family.

Make signs such as stop signs, store signs, street signs, and titles for projects.

Students can set up source and path of electricity from dam to the home.

Young children will think of more uses of sand than any teacher could possibly develop.

SANDBOX ACTIVITIES

Area #1 - Sandbox

The Sandbox - though this item is typically thought of as a nice thing for little kids, its use by upper grade level children is nearly limitless. It was a sad day when sandboxes were removed from many public classrooms. A water supply should be available and tools for digging, molding, etc. There should be a quantity of different kinds of soil and sand for experimentation.

GENERAL ACTIVITIES

Mold wet sand in containers to make houses. Talk about shapes and sizes, build roads, lakes, tunnels, birthday cakes, etc.

At this "me, my" stage of development, a child is most apt to explore things most closely related to himself: building my house, my garage, my farm.

Adding small plastic or wooden animals, cars, people, and boats, can create many situations from the child's world and set the stage for role playing, etc.

Learning to share is extremely important, and building and manufacturing can set up sharing activities.

Use to plan model communities keeping in mind environmental factors.

Set up topographical maps, building plateaus, steppes, mesa, island, peninsula, etc.

How much more real concepts of the world become when research is undertaken to develop a model of an area. This pliable, easily used and changed medium can be used to portray everything from the dinosaurs' world to the city of the future. Moon scapes, Indian villages, or volcanos are settings for basic understandings of history and geography.

Students can become involved with the study of erosion. Make a slanted erosion table and use layers of various kinds of sands to show cliff formations, etc.

Additional work in counting, matching 1-1, sets: Here is a set of cows for your farm - please count how many you have in that set. If you join your set of cows with Billy's set of cows, how many will you have?

Use estimation to know how many sticks you will need to build a fence if they are this far apart.

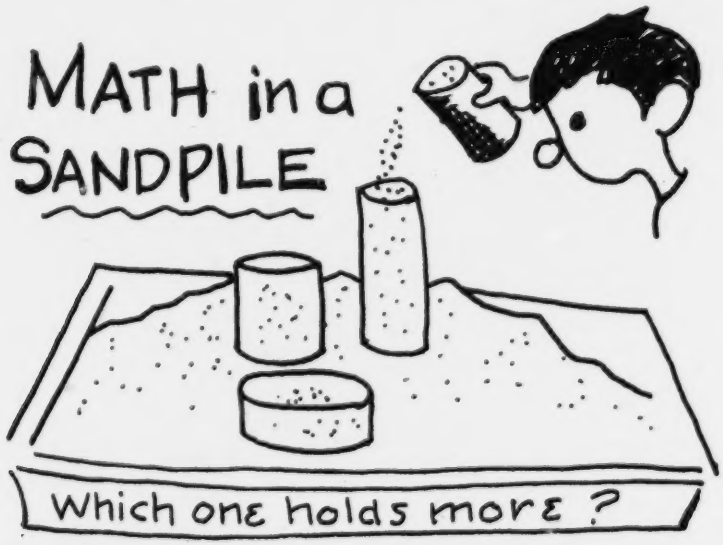
Use sand for weighing and measuring. Set up scale communities and use to figure out problems of distance, etc.

The sandbox can be used for setting up problems relating to area, perimeter, and circumference.

Use different kinds of sand for tactile approach, for size, heaviness, and shape. Use containers which hold more, less, heavier, lighter, and make patterns.

Older students might want to get involved with balances for comparing weight, studying ratio, etc. Place a number (5, 10) or whatever student wants to work with in a paper cup - (you will be comparing pebbles of different sizes). How many smaller pebbles will balance the larger pieces? You might come up with some interesting ratio problems. Does shape make a difference? Does weight make a difference? Weigh 15 of one size sand - will 15 of same size, only another sample weigh the same? An equal arm balance, made of wood or factory made, would be satisfactory. Use different types of scales for comparison purposes.

Treasure mapping may be set up. Let children hide prizes and make up maps for other children to follow for hidden treasure. You can also set up coordinates with string attached. Find treasures by reading the coordinates.



Sandpile Art

Sand candles may be manufactured.

Sand casting can be set up by making designs filled with plaster or cement. Remove when it becomes hard.

Make an interesting design - color an object with glue and roll in sand for a different effect.

Simple sand painting can be made by drawing on paper with glue and then sprinkling with sand, using a variety of colors, textures, and sizes.

Sand sculpture is an art - castles, forts, houses of different shapes and styles, and other creations can be manufactured.

Symbols in sand can be accomplished by drawing with the finger; lines and establishment of territories can be accomplished.

SANDPILE ART

Language Arts in a Sandpile

Introduce words such as add, take away, first, second, and third.

Develop vocabulary such as size, shape, and texture, and describe what you are building.

Role playing activities can be set up.

Use the sandbox to help children understand concepts they may need in beginning stories and literature.

Enlarge on vocabulary by expanding measurement activities.

Use sandbox or sand trays for kinesthetic approach to writing and reading. Make kinesthetic word cards by spelling letters or words in glue and sprinkling with sand.

The teacher can guide with questions, reinforce, and introduce words and language which describe or explain.

Students can write stories by setting key scenes in the sand box. Pictures can be taken for future story development. The sandbox can be quickly changed and adapted to fit the situation.

DIRT MOUNTAIN ACTIVITIES

Area #2 - Dirt Mountain

The Dirt Mountain may be the unloveliest part of an outdoor education center, but the most valuable teaching tool. A large pile of dirt, digging tools, (old large spoons are preferable because they have stronger handles and a minimum of sharp edges.) a collection of small cars and trucks, availability of a supply of water, and containers for measuring.

If possible, this should be built with different types of soil and colors. Some gravel or rock should be included. A water source should be available with hoses. Some areas may already have a natural embankment that is usable.

Clay Pit -

Locate a pit in the area near the mountainous region, where students can manipulate clay and for usage in soil experiments, ceramics work, Indian study, adobe work, brick making, and other uses of clay. Most schools are not located where natural clays are readily available, so clay may have to be imported from other areas and pit refilled from time to time.

DIRT MOUNTAIN

General

Use mud to make "adobe" or mud bricks for use in construction. Make a variety of shapes.

Construct natural features pertinent to concepts needed by students for understanding science, social studies, or vocabulary in literature such as hills, foothills, arroyo, canyon, mesa, steppes, chasm, cliff, crevice, etc.

Use inclined roads to study and measure speed; figure problems in speed and friction, safety, acceleration, curves, banked roads, and ways to overcome natural barriers.

Study erosion control, terracing, strip farming; use sticks, branches, and other to show erosion control. Grass seed or other non-permanent type plantings may be used.

Social Studies

Build a topographical map of region - of continental divide - of country under study - or other. Study problems and assets of area, and how land features have determined population growth.

Use heavy blocks of concrete or ice to study effects of glacial erosion and learn terminology connected with the subject.

Build and develop concepts of tunnels, caves, rivers, streams, brooks, etc.

Construct a system of dams, using different types: beaver, wood, dirt, concrete, curved, straight. What factors must be taken into account in building dams? What happens to areas behind a dam?

Lay out water shed and tributary systems.

Set up irrigation systems and different methods of irrigation.

Find ways to divert water from a "wet"side of a mountain to a dry side.

Find ways to make water travel up hill.

Study natural and man-made channelization of rivers. Cause rivers to seek new channels.

Set up model communities and study the effects of a flood. Which areas are safe? How can a flood prone area help prevent future floods?

Build water sources of different sizes and problems. How will bridges help them?

Find ways to reclaim land under water through land fill, dikes, etc. What needs to be considered when building or living on a water unstable area.

Study methods of transportation used in high countries, (animal, skis, cog railroads, railroads, cable transit, etc.).

Collect articles from the newspaper and magazines concerning problems dealing with flooding, mining, and transportation.

How did early settlers solve problems of laying out mountain trails, finding routes, water supplies, moving wagons up and down steep cliffs?

What types of problems confronted the mountain Indians? How did his life style differ from that of plains or coastal Indians? What materials would he use? What was his transportation like? What type of housing did he use? What problems did he have to overcome concerning winter survival?

Study animals of mountainous and other areas in connection with terrain and adaptations necessary to life.

What happened when people were cut off from other civilizations for hundreds of years? What things in their environment most influenced their lives: religion, folk medicines, tales, etc.?

Choose a country to study. Understand all you can about the environment and how conditions can affect the environment: disease, overcrowding, war, human greed, flooding and other problems that may have changed the environment of the country.

Young children will enjoy building miniature farms using natural materials such as twigs for fences, etc.

Tour your local city. Find the original site - decide whether you would have built your city at that site or would you have built it elsewhere.

Study history of floods and other environmental disasters.

Study climate and elevation to understand location of metropolitan areas; study problems of future growth.

What happened to parts of your state that may now be dust bowls?

Study Indian Artifacts common to your environment, if available, and study how Indians lived and survived.

Reproduce an early Spanish settlement. What crops were there and how did the people live?

Build a model of Mesa Verde. Study materials - what animals and crops were indigenous to the area? How did their environment influence their lives? Does Mesa Verde have anything to offer for the future? What do you think happened to the people of Mesa Verde?

Rock Collection Stations - These can be small areas around the base of a tree, paths through a flower bed or small concentric shapes outlined by cement, bricks, large rocks or other. The areas are to be filled with the interesting or "pretty" rocks children find. They can be reexamined, reclassified, and sorted constantly. Some areas can be located for classification of rock by igneous, sedimentary, or metamorphic. They can be cemented in by type of rock along the path, or each region may have a cross section of rock native to that area imbedded in the soil. Students need opportunities to realize the importance rocks play in our lives and the beauty they afford us.

Develop an appreciation of rocks - Have students select five or six rocks for studying. Have them observe shape, color, size, and weight. Use an equal arm balance for comparison purposes. Is it attracted to a magnet? Will it dissolve in water? What happens when you put it in vinegar? Does it scratch easily? Will it break into pieces if you drop it from shoulder heighth? Try to collect rocks that are sedimentary, igneous, metamorphic - set aside an area for rock study. Build a wall in the environmental center with different classes of rocks. Students might collect commercial building stones (polished), and also might have a rock hound visit and show and explain how rocks are polished and used in bracelets, pendants, bolo-ties, etc. Perhaps a boulder scatter field can be established - use large round rocks for climbing purposes. An interest center can be developed in your room emphasizing rocks. Pictures, magazines, books, minerals, other kinds of rocks, rock collections, rock testing ideas, and ideas bringing out the beauty of rocks should be utilized.

Observe differences in leaf arrangements, sizes and shapes - Classify

Students can gain a great deal of enjoyment by establishing a garden. They can obtain the seeds, do the planting and prepare the soil. They will need to study the amount of water for a certain plant, the amount of time in which normal germination takes place, and when the radish, or whatever, is ready for harvesting. A small section can be set aside for this activity. Depending upon the climate, plants having a short germination time and a short harvest time probably should be planted, due to summer vacations, and other problems that may arise due to not having anyone taking care of the garden.

Compare amount of moisture that might be needed for different plants. Example - differences between zones or regions. Several of the same plants might be selected and a record of moisture might be kept - one cup, two cups, 2 ounces, etc. - the same amount of water should be given to the same plant for determining amount of moisture that is needed for proper growth.

Students can begin gathering branches in February for a study of bud development. These can be gathered from the center or from their own yards. Have the students cut the live twig and place it in a milk carton or other container. Keep the container filled with water for proper development and have students observe changes that take place during the next few weeks. They can keep excellent records by drawing the changes in their art class or in their science activities. Keep an accurate record by scaling twigs, (size) recording bud and leaf colors as they are, and adding additional buds and dates as they occur. They can also record changes by writing a story, taping, or other related activities. When they move out to the center they should have a good idea of bud development, alternating and other budding arrangements. They should also commence observing more closely.

Make leaf prints using colored paint method, carbon paper method, and by pressing leaves in a book. Leaves can be collected from the same tree on a weekly, semi-monthly, or other time designated by the student. Collecting from the same tree will give the student an idea of growth change, color change, and will observe other changes such as worms, or other animals that may be infesting the tree. A stereo-scopic microscope would be an excellent tool to have for observing veination, and looking more closely at the leaf. Compare rate of drop (leaf), rate of color change, differences in size, color, odor, texture, and other changes that take place.

WATER ACTIVITIES

The water area - can be transportable - some outdoor areas are not compatible with ponds or pools, but a small plastic wading pool, a hose, a couple of wash tubs, an old fashioned hand pump, and materials for making an erosion table can set up opportunities for a lot of learning. Collect to go with this bubble pipes, materials to experiment with flotation, liquid measure containers, clear-tubes with corks that fit in both ends, a variety of containers to teach evaporation, etc.

Discuss taste, smell, and feel; listen to it drip, or spill, and observe color. They can compare their ideas with relation to pop, milk, and perhaps other liquids such as vinegar.

Allow the students to blow bubbles, spray, fill different size and shaped containers. How many spoons, full of water, fill a cup?

Students might compare how water runs as compared to soapy water, syrup, and other liquids.

After a rain or snow, where, how, and why do puddles form? What happens to the puddles? Do they stay the same size? Is a puddle good or bad? How do we get rid of an unwanted puddle?

Where does rain go when it falls?

Have students build ditches, canals, brooks, rivers, and lakes.

Construct an irrigation system for easy watering of an outdoor area of your school garden.

Collect samples of water from rain puddles, local drainage ditches, from nearby ponds, lakes, or other sources of water. Discuss likes and differences.

Set up simple evaporation problems by having students use jars or whatever container is available that can be easily seen through. Students can mark the top of the water level and discuss where the water is going. Does it evaporate rapidly? slowly? Mark the level each day.

What happens when you place a sponge in a jar or cup of water?

What happens when you place different kinds of soap (bars) in a pan of water? Make sure you slip in one bar of Ivory Soap.

What happens when you place other kinds of objects in the water? Use objects that float such as a cork and stick, objects that sink such as nails, bolts, and rocks, and objects that dissolve such as alka seltzer and sugar. Discuss findings.

Students can make different types of boats out of driftwood, cork material, and other types of material such as clay. Clay can be used to make many sizes and shapes of boats. Which floats best?

What happens when you mix water with bread, clay, rocks, paper of different kinds, cloth, dirt, sugar, or other types of materials?

Place a paper towel next to a drop of water. What happens? Do the same thing with syrup, cooking oil, and other liquids. Make comparisons.

What happens to water during cooking activities? What happens to water when it is being boiled?

Can you waterproof materials to make them float? How can you waterproof something?

How do animals such as fish, ducks, and others use water? How do they propel themselves through the water?

The marsh area will be an excellent place for collecting microscopic specimens for study. Algae and other life may be available for study.

What happens to your marsh plants if all the moisture evaporates?

What kind of plants do you find in this area? Are the growing problems different from plants located in the mountain area? Semi-arid area? Temperate zone area? Arid region?

Collect water samples from your home and bring to school. Compare color, and amount of material in the water. What is wrong if there are differences?

Who can help you determine what is in the water? Check with your local water board.

What happens when you place water next to different types of liquids?

Place a drop of water on wax paper. What is its shape? Try the same thing with vinegar, syrup, or other liquids. Make comparisons. What happens when you place drops of water next to each other?

Manufacture a water drop microscope.

Compare the cleanliness of water from running streams, lakes, ponds, swamps, and still pools. Is there any differences in contamination possibilities?

Graph the rate water disappears by daily measuring the differences. Use centimeters or inches and make a line graph or a bar graph. See Appendix.

Compare water dripping with other fluids. Is the rate of dripping the same? Can you graph the rate? See Appendix.

Check the number of drips made within a minute or use a metranome for counting. Use other liquids and compare figures.

What happens when water is placed on bread and placed in a baggie? What happens when another piece of the same bread, is placed in a baggie with no water?

Does it make any difference where you place the experiment - in the light, dark, a drawer, refrigerator, in the desk, or other place? Check periodically for results.

Is water a conductor of electricity? Perhaps a circuit can be devised to determine if this is a possibility. Do research on this project. Can other liquids be used for conduction experiments?

Water can carry disease and pollution. Use kool aid or dye to discover dissolving and distributing characteristics of water.

Study water as a means of transportation, and the history of transporting goods, cattle, etc. by water.

Measure puddles - size (width, length, and depth). Check and measure daily the size and compare with the size of the original puddle. Which puddle will disappear first - estimate time it will take for the puddle to evaporate. Predict where puddles will appear and predict size in relationship to amount of water.

Set out a rain guage - make your own - check with the weather instrument activities. Compare results with results shown in the newspaper.

Collect, read, and report and write stories concerning water problems.

Collect articles from newspapers, magazines, and other news media for information regarding water and problems relating to water.

Prepare a newscast describing a flood, or pollution problems in your local area.

Make a list of benefits we obtain from water in the area of recreation.

Use a language experience approach for developing concepts about water, lakes, puddles, etc.

Related Activities - Problems and questions

Check with the Federal Water Pollution Control - a part of the Department of the Interior - for recent controls regulating pollution.

What is a variance? How does this affect big business?

Is water an acid, base, or neutral? How can you find out?

What are methods used for treating water for drinking and swimming? Why are such methods used?

How is water used in big business such as steel mills? mining?

How do you handle flood control? Construct a variety of dams to see which work best.

How can you make water go up hill? (siphon, pumps, and locks)

How can water be brought to arid regions? (pipes, tunnels, canals, boat)

How do you handle insect and other animals that infest certain water areas?

What affect do chemical compounds have on water resources? What does toxic mean? What is a chemical contaminant?

What is the annual water consumption (for domestic purposes)? Check your water board for help.

Where does your local water source come from: Trace the source on a map.

Is your water table the same as it was 50 years ago? 5 years? 2 years?

What are the types of pollution that we find in our water? We might be talking about streams, lakes, rivers, or local drinking water.

Study flood control nationally - T.V.A. and its benefits. How has it affected the life of the south?

Is flood control always beneficial? What about the Nile?

Has water had anything to do with establishing communities? - civilizations?

Make and use a simple bar graph for demonstrating population in relation to water supply.

Weather Station - Students can build a weather station during their science instructional classroom time. They can record climatic changes and make comparisons concerning growth patterns of plants. Ideas concerning construction can be obtained from fifth and sixth grade science books.

Purchase good weather instruments for comparing information obtained from home made instruments. Is there a difference?

Prepare weather maps, develop a system for identifying cloud formations, and establish an area in the school for showing weather conditions etc. Perhaps a centralized bulletin board for all to observe.

Micro-Climates - Windbreaks can be established for developing micro-climates - this will establish a different type of environment. Students can make comparisons of changes in the environment. Smaller sub-climates can be established by planting bushes, etc.

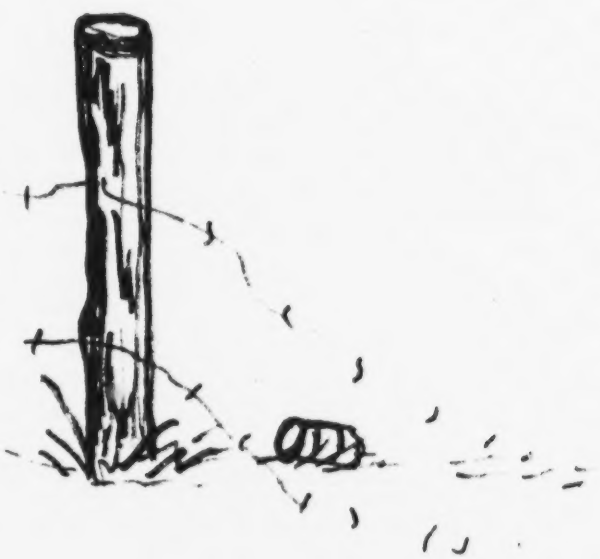
THE COMMUNITY IS AN ENVIRONMENTAL CENTER

Students can become more involved with attempting to understand the total community by getting better acquainted with the immediate school community by becoming involved with activities such as walks, map making, and inviting local community members to come visit with them about the history of the community. Establish surveys to help determine local needs such as housing, paving, parks, and lighting. Take photographs of the area and keep a record of community growth. Letter writing to local, state, and national leaders may be beneficial for correcting problems and for becoming more aware of needs. Become more familiar with current legislation concerning environmental concerns. They might become involved with campaigns that might be useful for helping people in need (helping with yard work for the elderly, cleaning and picking up trash, and running errands). Establish a school communication center. The students can write to all agencies that affect the welfare of the community and begin to stock items that can be easily picked up by adults from the community.

Take walks around the neighborhood and look at grass, shrubs, flowers, trees, and anything else the students can take in - talk about the beauty of the neighborhood. Students might be able to identify problems, such as what should be done with dead trees? What happens when there are too many people in the neighborhood? What happens when there is no grass, trees, or shrubs? What should be done with the junk in the back of some neighbor's yard? What should be done with trash that is lying in the streets? Questions like these will create excellent discussion and may develop more of an interest in the neighborhood environment.

Students can take pictures of the neighborhood using a camera. The camera technique is excellent for taking pictures of the neighborhood to show strengths and weaknesses, and also very good for recording improvement and keeping a record of growth.

Have students prepare maps of the immediate center, the neighborhood, and use scaling techniques as much as possible.



Regional Centers
Classroom

The regional center should be used for leisure recreation, reading, relaxing, art projects motivated by plants, rocks, etc., for writing poetry, story telling, dramatization, and puppetry. In addition, many other uses can and should be considered. What types of activities can be established and completed in the classroom that will help make the students experience more meaningful and richer when the outdoor center is used? The next several pages will be devoted to supportive activities. There are many fine experimental kits being produced that are involvement-oriented that would fit nicely into this program.

Magnifying glasses and a microscopic center - Use a simple 10 or 100 power scope. Collect a box of materials for students to study closely, such as different sizes of grass, leaves, small twigs, plants, cloth of different kinds and texture, pieces of newspaper with different size of print, different colors of construction paper, paper with smooth and torn edges, nylon, rope, printing, and other items. The students can study these materials under a scope at their convenience, or when it is their turn to work at that center.

Develop a question and motivational center. Books, magazines, current controversies, pictures, thoughts, a question box for any questions students might have concerning their own thoughts concerning environmental study.

Growing seeds gives children an opportunity to become acquainted with plant study at a very early age. Present the children with a collection of small objects including seeds of different kinds, pebbles of different shapes and color, wax, pieces of crayola, small pieces of wood, beads of different size, and any other small object that you might feel appropriate for this type of activity. Allow the students the opportunity to group the objects like they want to. Examples: (Seeds and non seeds - soft and hard - by shapes - color - or other groupings). Questions such as the following can be asked:

1. What are they?
2. Which will grow and which ones will not?
3. How do they feel?
4. How can we find out if they will grow?

The next step would be to soak seeds such as corn, lima beans, and pinto beans for further observation and study. Lima beans are excellent for smaller children because they are larger and it is easier to observe the embryo. Soak the seeds for approximately 24 hours. What is the difference between seeds that have been soaked and those that have not been soaked? Encourage discussion.

Allow the students to open the soaked seeds for observation. What do you see inside the seed?

Have the students prepare containers for planting purposes. They can use different types of soil for different growth patterns. They should also take care of their own plants for determining needs. Students can begin graphing (See Appendix) growth and discussing difference in plant growth. Discussion questions such as Why is his plant taller than mine should be discussed. What happened to the plant that grew poorly?

Many fine activities can develop from seed study. Perhaps studying different rates of seed germination would be valuable for older students and for students who would like to work on independent projects. Excellent seeds for studying germination might be mung beans, and radish seeds. They both germinate very rapidly. Seed germination kits can be purchased from different biological companies.

The Interest Center Activities

The interest center is an area or table set aside for focusing in on an area of interest such as birds, or a place for students to manufacture and create. The center or centers may be changed from time to time for motivation and for a place for students to work when they are finished with their basic assignment. Students may help develop centers, along with parents, and their ideas can be very helpful in designing new centers.

Activity cards may be developed for individual interest and for individual needs. Three by five or five by seven cards may be used with the basic activity and materials needed for the completion of a project. Please allow room for student creativity.

Perhaps centers can be established with some basic equipment for students to use at their leisure.

Nature Games

Materials: None

Objectives:

1. People will enjoy participating in games which will lead toward awareness and learning about nature.

Procedure:

1. Nature scavenger hunt. Make lists of natural objects to be found (specific leaves, rocks, insects, seeds, etc.). Distribute lists to individuals or groups. Set a time limit on the hunt and define the area in which the hunt is to take place. The individual or groups with the most objects found is the winner.
2. Nature Alphabet game. Have people (individually or in groups) find 26 objects in the environment each of which has a name which begins with a different letter of the alphabet. Set a time limit on the hunt and define the area in which the hunt is to take place. The individual or group with the most objects found is the winner.
3. Nature show and tell. Have a different person each day bring in an object from the environment which he will show and tell about to the class. Questions for further inquiry will be generated from this sharing experience. Ask what the object means to him, how he would like to use it, etc.
4. Me and my senses. This game should be played in an area which has a high degree of environmental diversity. Set the persons (4 per group) in a circle and designate who will begin. The first player says, "Me and my eyes see _____(naming something seen); the second player must find what the first player has seen and say, "Me and my eyes see _____" and "Me and my ears hear_____." This is continued using any of the five senses the person chooses. If a mistake is made, the person making the mistake leaves the circle. The last person remaining in the circle is the winner.
5. Nature quessing game. People sit down in a circle and a person is chosen to begin the game. The first person says, "I see (hear, smell,...) something which is _____ (gives one clue)." The rest of the people ask questions about the object (e.g. is it green, is it an animal,...) until someone guesses what is seen. The person accurately identifying the object then becomes the new leader and the game continues.

6. Nature Rummy. The teacher collects 52 natural objects and places them in a "feely box" (a box into which hands and arms can be inserted, without a person being able to see what is inside). Four persons then take seven objects each out of the box and place them in front of them. Designate the person who will start the game. Players take turns rotating in clockwise direction. The object of the game is to get seven objects into groups of three or more on the basis of similarities. The first person to accomplish this is the winner. During each player's turn, he must: (1) take one additional object out of the box, (2) group (in sets of three or more) as many of his objects as he can, and (3) return one object to the box. A variation of the game could require the winner to get seven different objects in front of him which are dissimilar.
7. Changing Leaders. Take the people on a hike (single file). Ask questions about what you can observe (e.g. "What is the name of this plant?", "What does this animal eat?", etc.) The first person to give a correct answer moves to the front of the line. An incorrect answer requires that a person go to the end of the line. There will be many winners in this game.
8. Hawkeye. Sit the people down and have them all concentrate their attention on a small diverse plot (you may want to place a string to designate the boundries of the plot). Ask three people to leave for a moment while the remaining persons move one object in the plot. When the three persons return, the first one to identify which object has been moved is the winner. The winner and two other persons leave the group and the game continues.
9. Nature Pantomime. The teacher makes up cards with a name of an environmental object (wind, sun, ant, daisy, etc.) on each one. Divide the class into two teams. Choose a person to start and give them a card. They must act-out (non-verbally) the object that is on their card until someone on their team accurately identifies what they are (a time limit of two minutes is suggested). Keep a record of the time it takes for each person/object to be identified. Alternate between groups until everyone has had a chance to pantomime. The team which identifies all the persons/objects in the least amount of time is the winner.
10. Nature crossword puzzle. Make a crossword puzzle using the characteristics (structures and functions) of environmental objects.
11. Nature matching game. Collect several environmental objects from the school grounds prior to class. Sit people down and hold up one object. Ask them to find another like it. The first person to return with a matching object is the winner. Continue the game.
12. Nature treasure hunt. Bury a "treasure" on the school ground and make a verbal map of how to find the buried treasure. Use the characteristics of objects, directions, and pacing to make your verbal map. (e.g. go to the object which is _____; take 40 paces south and 20 paces west and here you will find an object which is _____; take 10 paces north and you will find an object which is _____; etc.) The person who finds the treasure first is the winner. This can be a team game if you choose.

13. Sense and tell. Blindfold one person and tie a piece of rope (10 feet) to his waist or belt. Have him move around in the environment (you hold the rope to ensure his safety) and ask him to identify 10 objects correctly. Keep a record of the time it takes each person to identify 10 objects. The person requiring the least amount of time is the winner. You may want to use one sense at a time as a variation of the game.
14. Nature fox and hare. Set up a field with a safe zone and a capture zone on each half of the area by designating a midline in between the two safe zones. Divide the class into two groups and assign the name "hares" to one group and "foxes" to the other. Have all the hares and foxes assemble in their own capture zone and await your instructions. You will be asking a series of true or false questions about the environment. If the answer is true, the foxes chase the hares and if it is false, the hares chase the foxes. Anyone caught by the other team before reaching the safe zone must join that team. Continue the game until everyone is either a hare or fox.

Blind Nature Walk

Materials:

1. Blindfolds

Objectives:

1. People will experience a greater sensitivity and awareness in their non-visual perception of the environment.
2. People will become aware of how dependent they are on the sense of sight in interpreting their environment.

Procedures:

1. Locate and go to an area outdoors which has a high degree of diversity in it (trees, gravel, concrete, grass, etc.).
2. Group the people in pairs.
3. Give the following set of instructions:
   a. One person in each pair is to be blindfolded for a period of 20 minutes while the other person leads them on a blind nature walk.
   b. After the 20 minutes period is over, the two people change roles for another 20 minute period.
   c. When leading the other person
      1. Do not talk.
      2. Move slowly and do not let go of the person. Be constantly aware that the person you are leading cannot see.
      3. Introduce the person to as much of the environment as you can. Remember that you are working with the senses of touch, sound, smell and taste.
      4. Do not force the person to do anything which she/he resists.
   d. When being led by the other person:
      1. Do not talk.
      2. Trust the person leading you to see that you won't be hurt.
      3. Try not to guess what you are experiencing: just experience the touch, sound, smell and taste of the environment.
   e. After both people in each pair have completed the blind nature walk, have them sit down and discuss the experience.
   f. A discussion of the experience with all the members of the class should prove worthwhile.

Environmental Collage

A. Materials:

1. Printed matter - magazines, newspapers, pictures, etc.
2. Mounting or backing materials - cardboard, posterboard, heavy paper etc.
3. Glue or paste.

B. Objectives:

1. People will become aware of some of their personal thoughts and feelings about the environment.
2. People will become aware of the fact that no two people feel and think exactly the same way about the environment.

C. Procedure:

1. People should be instructed to design and create an environmental collage which shows their feelings and thoughts about the environment.
2. Completed collages should be hung together for the purpose of sharing ideas and feelings to facilitate the realization that each person thinks and feels differently about the environment.

The Word is Not the Thing

Materials:

1. Notebook and pencil

Objectives:

1. People will become aware of the fact that things have a reality beyond the words and symbols used to represent them.
2. People will become aware that they can never know everything about anything.
3. People will encounter the subjectivity of the environment and, in doing so, encounter their own subjectivity.

Procedure:

1. Have each person locate a tree, a rock, flower, etc. and sit down about 50 feet away from it. At this distance, each person should be instructed to write a complete description of the chosen object.
2. Next, have each person move up to a distance of 10 feet away from the object. Each person should now add new observations to his description of the object.
3. Now, have each person move up to the object and feel, smell, taste, look at and listen to the object. Once again, each person should add new observations to her description of the object.
4. Have each person read their description of their chosen object. Have they said all they can say about the object? Is there still more to the object than what they have written? How do they know?

My Favorite Place

Materials: None

Objectives:

1. People will become aware of the fact that each person is different in the way he perceives the environment.
2. People will increase their observational abilities.

Procedure:

1. Locate and go to an area outdoors which offers a high degree of diversity.
2. Instruct each person to wonder randomly within the area for 20 minutes being as observant as they can be.
3. Ask them to choose the one place which they prefer to all the other places in the area.
4. Have them return to their prefered area for a period of 10 minutes and sit down there and try to discover why they prefer their place to all other places.
5. Group the people in pairs and have them go to their favorite places and share them with each other.

No Two Things are Exactly Alike

Materials: None

Objectives:

1. People will become aware of the diversity which exists in the environment and the fact that no two things are exactly alike.
2. People will become aware that things take on different meaning when experienced against different background.
3. People will become aware that they are each "makers of meaning."

Procedure:

1. Have the people walk around the school grounds and look for two stones which are exactly alike. (about 10 minutes is sufficient.)
2. When they have selected two stones that they are satisfied with, ask them to sit down.
3. Ask them to divide into two groups on the basis of whether or not these stones are exactly alike.
4. Tell them they can change groups whenever they change their mind about whether or not their stones are exactly alike.
5. Have the people continue to examine their stones for differences and similarities. Ask them to check out the following: color, shape, texture, markings, taste, smell, sound, etc.
6. At this point everyone should be in the group which believes their stones are not exactly alike. Individual help may be necessary for a few of your students.
7. Have each person choose the one stone that she/he prefers over the other stone. Have them put their favorite stone in front of them and put the other stone away.
8. Have each person write a story about why he/she likes the stone he chose and what it means to him.
9. Have the people share their stories about their stones with each other.
10. Discuss the following questions:
    a. Where is meaning?
    b. Would the stones have any meaning if there were no people?
    c. Do different people make different meanings?
11. Have the people put the stone in a new environment (in their shoe, in the rock collection, in their pocket, etc.). Ask them if the stone has taken on any new or different meaning in its new environment.
12. Have each person describe (speech, writing, art, or drama) how he would like most to use his stone. What it said will reveal a great deal more about the child than the stone.

13. Encourage the people to use their stone, in the ways they described they would like to.
14. Discuss the following statements:
    a. "What you see is what you are"
    b. "What you see is what you get"

Environmental Plot Study

Materials:

1. Notebook and pencil

Objectives:

1. People will become aware of temporal - spatial changes in the environment.
2. People will personally identify with a small part of the environment.

Procedure:

1. Have each person choose a small plot of land (no larger than 10' x 10') that they would like to study for a period of five or more weeks.
2. Instruct each person to describe or identify (not necessarily by scientific name) everything in their chosen plot and draw a map or take a photograph of it.
3. Each person should return to their plot once each week and record any changes which have taken place since their last observation.
4. During their final observation of the plot, each person should think of how they would like to change their plot to make it a better place to relate to. If their changes are feasible, let them change the plot.

Further Experiences:

1. Water your plot everyday for a period of three weeks and observe the changes that take place.

Classroom Environmental Inventory

Materials:

1. Notebook and pencil

Objectives:

1. People will begin to understand energy and matter relations as cyclic rather than linear.
2. People will become more aware of the classroom as an environment and the effects it is having on them.

Procedure:

1. Group people into small groups and give them the task of making an environmental inventory of the classroom.
2. Provide the following set of questions to guide them:
   a. What is the predominant smell, sound, taste, texture and color in the room?
   b. Of what materials (wood, metals, plastics, glass, etc.) are the room and structures in the room constructed?
   c. What are the sources (where they come from) of the materials in the room?
   d. Which materials in the room are permanent and which are transient?
   e. What happens to the transient materials once they have served their immediate purpose?
   f. In what shapes and patterns do the various materials in the room exist?
   g. In what ways could the various structures in the room be interchanged or rearranged so as to make the room more useful or comfortable to be in?
   h. What are the various forms of energy (chemical, radiant, electrical, etc.) which can be found in the room?
   i. What are the sources of the various forms of energy which you have identified?
   j. What work are the various forms of energy performing in the room?
   k. Once the energy performs work in the room, what happens to it and where does it go?
   l. In what ways are the various materials (forms of matter) and energy interacting together in the room?
   m. What other materials and/or forms of energy would you like to bring into the room?
   n. What are some ways that you can make better use of the materials and energy in the room?
3. Let the people make alternative designs for the classroom and try some of their ideas.
4. Apply the same inventory to the school building, school grounds, school district and their own homes.

Daily Environmental Awareness Diary

Materials:

1. Notebook and pencil

Objective:

1. People will become more aware of their environment and the effects their environment is having on them.

Procedure:

1. Each person should choose a specific time of the day during which they are most likely to be in different palces from day to day.
2. Each day for a period of 3 weeks, and at their chosen time, people should be instructed to pause for a few minutes and concentrate on the environment around them. What do they like? What don't they like? What seems to be having no effect on them at all?
3. Instruct people to make daily entries in their diary describing how they were relating to their environment.
4. Share awarenesses with others.

Diary of a Polluter

Materials:

1. Notebook and pencil

Objectives:

1. People will become aware of the fact that each person is responsible for pollution.
2. People will begin to perceive energy and matter relations as cyclic rather than linear.

Procedure:

1. Tell people that they are the polluter in this exercise.
2. Have each person write a daily log of the types and amounts of pollution they are personally responsible for.
3. Remind them that almost every activity of their lives (yours too) produces some kind of pollution.
4. Personal pollution could include air, water, noise, heat, solid waste pollution, etc.
5. Share and discuss the diaries with each other in class.

Centering

Materials:

1. Notebook and pencil

Objectives:

1. People will discover what various material things mean to them personally.
2. People will have an opportunity to consider alternative life styles in relation to their use of material things.

Procedure:

1. Ask each person to choose some material thing (television, car, radio, phonograph, water, tape player, meat, motorcycle, cosmetics, dishwasher, automatic washing machine and dryer, items of clothing, etc.) that they would be willing to go without for a period of time (one week is usually sufficient).
2. Each person should be instructed to keep a record of their thoughts and feelings about what was lost and what was gained during the experience.
3. Do they feel and think the same way after the experience as they did before?
4. Give each person the opportunity to write a new life style for themselves in relation to the material thing they deprived themselves of.
5. Encourage them to repeat the exercise with other material things.

Developing Miniature Environments or Habitats

Materials:

1. Plexi-glass or plastic shoe boxes, hat boxes, and sweater boxes.
2. Cages made out of wood or fine wire mesh.
3. Cardboard shoe boxes with wire mesh on top.

Procedure:

1. Cut a section from the lid of the plastic container. This can be done with a heated knife or other tool that can cut through the material. Replace the cut out section with wire mesh. This allows for a proper air environment.

Objectives:

1. Development of interest in different environments.
2. Development of observational skills.
3. Development of skills in setting up habitat.
4. Development of research skills.

Possible suggestions:

1. Old leaves that have set for a long time - set or dry.
2. A small area that has Ant Lions living in it.
3. A piece of a dead log.
4. A tree branch that has been infested with bugs.
5. Weeds, along with the dirt, roots, etc.
6. Dig a sample of soil from different parts of your yard.
7. Weeds, soil and appropriate animals involved with the environment.
8. Dry or wet soil with worms, etc.

The sample should be of sufficient quantity for maintaining the natural habitat.

Questions:

1. Will climatic change create a change in the natural environment?
2. Can the small habitat maintain life without expanding the amount of soil, plants, etc.?
3. Can you observe changes that take place because of the environmental movement?

Students can keep independent records and can change environments when there is a need.

Please see the appendix for ideas concerning construction of the cages.

A Litter Experience Goes A Long Way

A. Materials:

1. Notebook and pencil
2. Litter bags
3. Balance or weight scales

B. Objectives:

1. People will become more aware of the amount, kinds and effects of litter in their environment.

2. People will become aware of some alternate uses for what was considered waste.

C. Procedure:

1. Go to an area which is littered (most anywhere will do).
2. Plot off an area of one-fourth acre.
3. Estimate the percent of the total surface area which is covered with litter in the plot.
4. Collect all the litter in the plot and take it back to the classroom.
5. Put each item of litter in one of two piles (one pile for those things which are biodegradable and one for those which are non-biodegradable).
6. Take the items in the non-biodegradable pile and place them in smaller piles (plastic, aluminum,, steel, glass, etc.).
7. Put the items in the biodegradable pile and place them in smaller piles (paper, plant matter, animal matter, etc.).
8. Weigh each pile and determine the percent composition of the total that each category of litter represents.
9. Make bar graphs to illustrate the results of the study.

D. Further experience:

1. Have people create something out of the litter they collected (mobiles, sculpture, etc.).
2. Select one item of litter from each category, weigh and bury them. After a period of three months, recover the buried items and reweigh them to measure any decomposition which took place.

Make Your Own Soap

Materials:

1. Kitchen grease and fat trimmings (those from beef, pork, or sheep are best)
2. Large enamel or iron pots (lye corrodes aluminium)
3. Household lye (obtained at grocery or drug store)
4. Distilled or soft water (the magnesium and calcium salts in Pueblo's water will prevent making soap)
5. Cheesecloth
6. Wooden stirring stick
7. Molds (shoe or cigar boxes, etc.)

Objectives:

1. People will learn how some of their great grandparents made their soap.
2. People will learn that animal fats need not be considered waste.

Procedure:

1. Have people bring kitchen grease and fat trimmings to school until you have accumulated about six pounds of clean fat. (be sure to refrigerate during storage)
2. Clean all the fat by boiling fat with equal parts of water. While the fat is boiling, stir and add a little water to compensate for evaporation. After about 10 to 15 minutes, strain the upper layer of fat through three layers of cheesecloth.
3. Dissolve 13 ounces of household lye, (a caution: do not get lye on your clothes, skin, or in your eyes. Lye can be neutralized with diluted vinegar) in 2 1/2 pints of cold water (use soft water or distilled water only). Add the lye slowly, a little at a time, stirring with a wooden stick. Allow solution to cool to room temperature.
4. Place six pounds of the cleaned fat in a pot and warm slowly until the fat reaches a temperature which just feels warm to the back of your hand.
5. While continuously stirring the fat add your lye solution slowly, a little at a time (this should take about 20 minutes). Continue stirring the solution for another hour.
6. After all the lye solution has been added, the soap mixture will gradually become thicker. When it has reached this condition, it is ready to pour into your molds. Aromatic oils and/or food colorings can be added at this point if you so desire.

7. Set your molds in a warm place for about one week. When the soap is hardened, peal away the cardboard and cut into bars of desired size.

Further Experiences:

1. Make "Indian" soap. Obtain the root of the local yucca plant. Wash the root thoroughly with water. Pound the root with a rock in a pan filled with a little soft or distilled water. Remove the root particles by straining the solution through cheesecloth. Add soft or distilled water to obtain the functional concentration. You have made a liquid soap as some Indians did in the past.
2. How is soap made today? Have people answer this question.

Classification and Set Theory

Materials: None

Objective:

1. People will learn how to classify natural objects.
2. People will learn set theory using natural objects.

Procedure:

1. People should be asked to collect 30 different objects from the environment and bring them to class.
2. Ask people to place their objects in groups according to the similarities and differences they can observe.
3. If people have been able to classify their objects, ask them to answer (in writing) the following questions which should reveal their understanding of set theory.
    a. How many objects are there in each set (group)?
    b. How many sets intersect (have similar parts)?
    c. How many equivalent sets are there?
    d. How many equal sets are there?
    e. How many disjoint sets are there?

Further Experiences:

1. Classify animals and plants.
2. Construct your own taxonomic keys to plants and animals (see BSCS Green Biology version).

Edible Wild Plants of the Pueblo Area

Materials: None

Objectives:

1. People will learn how to identify and prepare edible wild plants or the Pueblo area.
2. People will learn about how Indians and early settlers in this area used wild plants for food.

Procedure:

1. If you want to learn how to prepare and use wild plants for food, you must be able to identify them. Many local persons (teachers, conservationists, garden club members, etc.) are competent in identification of local plants and should be called upon for help if needed.
2. The best reference for edible plants in this area is:
   Harrington, H.D. 1972. Western Edible Wild Plants. University of New Mexico Press, Albuquerque. $2.95.
   This book includes recipes for and, folklore about wild edible plants. Some of the plants described in Harrington's book, and which can be found here are: Cattail, Wild Onion, Dandelion, Milkweed, Shepherd's Purse, Tumbleweed, Purslane, Lambs Quarters, Violets, Pinon Pine, Yucca, Prickly Pear and Sunflower.

Further Experiences:

1. Learn to prepare some of these foods from wild plants and share them with parents and/or other persons at school (lunch would be an ideal time).
2. Learn to identify and prepare some of the local mushrooms. Once again get help on identification if needed and use the following book:
   Wells, M.H. and D.H. Mitchel. 1966. Colorado Mushrooms. Museum Pictorial No. 17. Denver Museum of Natural History, Denver.

Arts and Crafts with Natural Materials

Materials: Collected from the environment

Objectives:

1. People will be able to express themselves creatively in arts and crafts using natural materials.

Procedure:

1. An excellent source for ideas is the book by Bale:
   Bale, R.O. 1959. Creative Nature Crafts
   Burgess Publishing Co.
   Minneapolis, Minn.
2. Some of the methods described in Bale and others (see Bibliography) are: nature prints, leaf skeletons, dried flowers, nature costume jewelry, native dyes, Christmas ornaments, weaving, straw crafts, musical instruments, cornhusk craft, plastic casting terrariums, etc.

Compost Pile and Earthworm Culture

Materials:

1. Sand (from river bottom or beach)
2. Garbage
3. Box
4. Plastic

Objectives:

1. People will become aware of the processes of decomposition, recycling, and soil formation.
2. People will learn the life cycle, and function of earthworms.

Procedure:

1. Obtain or construct a box (approximately 24" x 24" x 9").
2. Line the bottom and sides of the box with plastic (used of course). Partition off a small area within the box to be used as a control for experiments and observations. Place the box indoors or out-of-doors.
3. Fill the control area with sand only.
4. Fill the box with sand and garbage (organic only) in the following manner:
    a. Cover a three inch deep layer of garbage with one inch deep layer of sand.
    b. Repeat as described above until you have your box filled.
5. After a week, and once each week thereafter, turn and mix the contents of your compost box. This will facilitate aeration and keep the compost aerobic.
6. Add water if the compost dries out, but don't overwater or the compost will become anaerobic and emit unpleasant ordors.
7. The addition of lime and rock phosphate will make the soil formed richer in plant nutrients.
8. Have people make observations comparing the sand in the control area to the soil being formed in the compost. (macroscopic and microscopic)

Further experiences:

1. Composting generates heat. Measure the temperature of the compost and the sand in the control periodically. Why is heat generated in the compost?
2. Different types of solid waste can be weighed, buried, recovered and reweighed to observe and measure decomposition rates.

3. Earthworms can be raised in your compost pile. They may be used for studying their life cycle, experiments, or as food for animals being kept in the classroom (not to mention fishing).
4. Turn your compost pile into a garden in the spring (see exercise on Organic Gardening).

Indoor Organic Gardening

Materials:

1. Fertile soil
2. Garden box-size optional
3. Seeds
4. Small garden tools
5. Sylvania Gro-lux flourescent bulb and fixture

Objectives:

1. People will become aware of how plants grow
2. People will learn how to care for plants

Procedure:

1. Obtain or construct a garden box (4' x 4' x 9" suggested). Line the box with plastic (used of course) and fill it with fertile soil.
2. Soils in this area are generally lacking in organic matter and tend to be alkaline. Work organic matter (see exercise on Compost Pile) into the soil to improve the soil.
3. Position your light source above your garden. The light source recommended closely simulates the spectral quality of sunlight and gives excellent results.
4. Choose and purchase the seed for your garden (suggested: radish, carrot, beans, beets, onion, spinach, cherry tomatoes).
5. Follow the planting instructions on the seed package.
6. Water and cultivate your garden as needed.
7. You may want to stretch string across the top of your garden in two directions to divide the garden up into individual plots for your people. Personal indentification with a part of the garden and a few plants will increase the interest of people in the garden.

Further experiences:

1. Thin most of the seeds planted numerously in rows when appropriate, but leave a small section unthinned to observe the effects of overcrowding.
2. Think of ways to alter the environment of your garden to show the effect of various environmental factors on the growth and development of plants.
3. Harvest your garden and prepare your vegetables in class if possible.
4. Encourage people to grow a garden of their own at home next spring and summer.

Ant Farms and Ant Behavior

Materials:

1. Scrap wood (2" x 2") obtained from lumber or milling company.
2. Window glass (10" x 16") use scrap if possible.
3. Ants (workers, soldiers, queen, larvae).

Objectives:

1. People will become aware of the individual and extra-specific behavior of ants.
2. People will become aware of the life cycle of ants.
3. People will become aware of the competition between ants of two different species for space, food, and water.

Procedure:

1. Construct a case for your ant farm. Slot 4 pieces of wood so that the glass will fit tightly to a depth of 1/2 inch. Fit the glass into the wood frame and glue three sides together. The top piece of wood should not be glued so as to facilitate to opening and closing of the case.
2. Go outside to collect ants for the ant farm. Collect the different types of ants from the ant hill (workers, soldiers, queen, larvae) and the materials which the ants were using for their hill. You may not find a queen (she is larger than the other ants) but the colony will live without her for a long enough period of time for your study.
3. Fill the case up to 2/3 with the material from the ant hill and add the ants you collected. Close the case by placing the top on firmly.
4. Observe and interpret the individual and group behavior of the ants (see Animal Behavior exercise).

Further Experiences:

1. Construct another ant farm as previously described. Use a different species of ant for the second farm.
2. Repeat your observations with the new species noting similarities and differences between this species and the first.
3. Set the ant farms side by side and connect them with a piece of plastic tubing. Note the effects the two populations (species) have on one another as they compete for space.
4. Connect a longer piece of plastic tubing extending from each ant farm to a common closed container. Place food

(sugar, honey, garbage) in the container and observe the ants as they compete for food. Record the rate at which they consume food.

5. Place a water-soaked sponge in the closed container and observe the ants as they compete for water. Record the rate at which they consume water.
6. Was the intensity of competition the same or different for space, food and water?
7. What is the purpose or function of competition? What does ecological niche mean?
8. Create experiments of your own.
9. Construct a Lubbock Ant-nest as an option or for additional studies (see Handbook of Nature Study by Comstock).

A Balanced Aquarium as a Microecosystem

A. Materials:

1. Wide-mouthed glass gallon jars.
2. Materials from lakes, ponds or streams.

B. Objectives:

1. People will become aware of the unique function (niche) of different organisms as they live interdependently together in a "balanced" system.
2. People will become aware of the interactions between the living and non-living components of a "balanced" system.

C. Procedure:

1. Construction of a balanced aquarium:
   a. A wide-mouthed gallon pickle jar is an ideal container for this project. You may be able to obtain one from the cafeteria kitchen, or local restaurant. Clean the jar thoroughly with hot water.
   b. Get some river or lake shore sand as free of dirt and debris as possible. Wash it thoroughly through several changes of water. Place the sand in the bottom of the container to a depth of two inches. Fill the container with water to a level so that when you put your hand to the bottom the water will not overflow. Allow the sand to settle until the water becomes reasonably clear.
   c. Put a number of aquatic plants into the aquarium. Collect them from a pond or a quiet pool in a stream or purchase them at an aquarium or pet store. It is best to have two or three kinds of plants, some floating (such as duck-weed), some rooted in the sand with the main plant body submerged in water (eel grass or elodea), and some rooted but having floating leaves. Watch size relationships. Do not put large plants into the smaller container (remember, plants grow).
   d. Put a few aquatic animals into the aquarium. Snails are the best animals for this size container. Larger animals would be difficult to support in so small an aquarium. Most snails are herbivores (plant eaters) and are more likely to find an adequate food supply here. Do not include tadpoles because these, as adult frogs, live outside of water. Do not include aquatic insects and fish. Many of them are carnivores (animal eaters) and probably would not have enough food and oxygen for very long. To support carnivores, a balanced aquarium would have to be much larger and contain many more plants and small herbivores. However, you will inevitably include some microscopic carnivores. Your aquarium will become balanced at snail level.

e. Cover the jar with its own lid, a glass cover, or Saran Wrap to minimize water loss through evaporation. Allow your aquarium to stand for at least two weeks. If at the end of two weeks, the water is clear, if it smells "fresh," and if the plants appear healthy and the animals are alive, the aquarium is probably in an approximate balance. The longer it continues in this condition, the more likely is the balance.

f. Your balanced aquarium will succeed in any window during the winter months. An east or north window is best for a year-round location because the aquarium is most stable in a place where it receives plenty of strong indirect light, and only a small amount of direct sunlight. In summer, west and south windows are too hot for the aquarium.

2. Make observations of the organisms in the "balanced" aquarium. Interpret your observations noting the interrelationships among the different organisms.

3. Although daily and seasonal light and temperature changes in the classroom are not as extreme as they are out-of-doors, they do occur. You can observe and interpret such changes and their influence on the organisms in your "balanced" aquarium during the day and/or as seasons change.

4. By monitoring changes in the dissolved oxygen content in your "balanced" aquarium (see Appendix for procedure), you can observe and interpret community metabolism.
   a. Cover two aquaria with a relatively light-proof object overnight. In the morning, measure and record the dissolved oxygen content of each aquarium. Allow one aquarium to remain covered and uncover the other. At the end of the day, once again measure and record the dissolved oxygen content of each aquarium.
   b. Photosynthesis and respiration occurred in the aquarium exposed to light, while only respiration occurred in the covered aquarium.
   c. A discussion of photosynthesis and respiration could follow this exercise.

5. Distortion in the form of increased heat, chemicals, etc., could be introduced into a "balanced" aquarium to observe its effects. A discussion of distortion in natural systems could follow this exercise.

Succession in Aquatic Microcosms

Materials:

1. Hay
2. Soil
3. Water from various aquatic habitats
4. Narrow-mouthed quart bottles
5. Compound microscope

Objectives:

1. People will become aware of the process of succession as it occurs in aquatic microcosms.
2. People will become aware of microscopic aquatic organisms.

Procedure:

1. Prepare a hay infusion medium by boiling (10 minutes) several pounds of hay in equal volume with distilled or pond water. Pour about 8 oz. of supernatant into a series of quart bottles. Stopper with cotton.
2. Prepare a soil nutrient medium by boiling several pounds of soil in equal volume with distilled or pond water. Pour about 8 oz. of supernatant into the same series of quart bottles. Stopper with cotton.
3. After one day, examine the aquatic medium in each bottle and describe what is observed.
4. Have people bring water from different places in the local environment (streams, ponds, drainage ditches, etc.).
5. Innoculate bottles with water collected by students using clean and separate medicine eye droppers or pipettes.
6. Examine the cultures in your bottles at approximately 3-day intervals. Mix the culture by rapidly rotating the bottle, remove (with pipette) and place one drop of the culture on a microscope slide. Examine with a compound microscope. Organisms can be sketched, identified and counted for abundance.
7. Have people keep a record of and interpret the qualitative and quantitative changes which take place in their cultures over about an 8-week period.
8. Population growth curves for different species can be plotted, interpreted, and compared.
9. Compare and contrast the results obtained in the different cultures.

Further Experiences:

1. Mix some of the cultures and observe and interpret the results.

2. Introduce some form of distortion (heat, chemicals, etc.,) and observe and interpret the results.
3. Challenge people to the task of obtaining a pure (not bacteria-free) culture of any one species.
4. Enclose a small area on the playground and watch the succession of species throughout the school year.

Community Structure Analysis

Materials:

1. Metric ruler
2. Shovel
3. Grocery bags (medium and small)
4. Small jars or bags
5. Piece of string 4 meters long
6. 4 large nails
7. Grass clippers
8. Scales or balance

Objectives:

1. People will become aware of the food chains (producers, herbivores, carnivores,) and trophic structures (ecological pyramids) which exist in communities.
2. People will become aware of the spatial distribution, relative abundance and ecological dominance of populations within communities.

Procedure:

1. Go to a stand of relatively undisturbed prairie. Divide the group into teams of approximately four people.
2. Have each group set up a quadrat (one meter square) in a place which they think is typical of the area.
3. Collect and count all of the animals found in the quadrat, and place each different species in a different container. Estimate a total space occupied by each species.
4. Classify (not necessarily according to proper name) and count all the plants in the quadrat. Estimate the total space occupied by each species.
5. Clip all of the above-ground parts of the plants and put them into a separate grocery bag.
6. Dig down into the soil to a depth of about 20 cm. and remove and count all of the species encountered. Place each species in a separate container.
7. The biomass (living weight) of each species should be determined with the use of a scale or a balance.
8. All species collected should be designated as producers, herbivores, or carnivores.
9. Ecological dominance can be interpreted from your data on the total space occupied by each species.
10. Relative abundance can be interpreted from your data on the numbers of individuals of the different species collected in reference to the total number of individuals of all species collected.

11. Trophic structure can be interpreted from your data on the biomass of each functioning group (producer, herbivore, carnivore) and plotting your data.
12. Compare results obtained by different teams. Discuss similarities and differences in results.

Further Experiences:

1. Repeat the study during different seasons to become aware of temporal changes.
2. Repeat the study in different environments (river bottom, back yard, schoolground, etc.) to become aware of environmental effects on communities.

Quadrat Data Sheet

Locality:
Quadrat number:
Quadrat size:

	No.	% Area	Trophic Level	Biomass/M^2

Animal Behavior

A. Materials:
   1. Behavior data sheet and pencil
   2. Pair of binoculars (optional)

B. Objectives:

   1. People will become aware of some of the individual and group behaviors exhibited by animals.

D. Procedure:

   1. Observe and interpret the behavior of wild or captive animals. The prairie dog town along the nature trail on the S.C.S.C. campus would be ideal for this study. Captive animals in the classroom or zoo would be a valuable alternative.
   2. People should be instructed to look for the following types of behavior:
      a. Maintenance behavior: Maintenance behavior includes such activities as feeding, drinking, locomotion, sleeping, shaking, rubbing and scratching, stretching, preening in birds, grooming in mammals, wallowing, bathing and shaking. Some maintenance activities evolve into display behavior, and are thus important to understand before studying display behavior.
      b. Display: Display plays a very significant role in the life of an animal and must be observed and interpreted both for cause and for function. The cause of display behavior involves the interaction internal and external stimuli in such a way as to lead to a specific behavior. The assessment of cause can be accomplished in three ways:
         1. The form of movement often indicates which tendencies (attack or escape) are involved.
         2. Clues to cause are often afforded by alternate shifting in behavior patterns between the individual initiating the behavior (the reactor) in relation to the particular display.
         3. Comparing situations which evoke agonistic displays with those which evoke pure attack and escape (territorial conflicts) should provide clues to understanding the cause of display behavior.

      The purposes of animal behavior can be assessed by observing the reaction of the recipient of the display. Display involved in pair formation and agonistic situations can result in increasing or decreasing the space between the individuals involved in the display. Distance-reducing displays are important in promoting social bonds between members of a pair, between young and parents, etc.

c. Song and voice: Song and voice are important isolating mechanisms. Record and analyze these communicative behaviors. Make a record of the situation under which calls and songs are given, the reaction of other individuals and the place from which the songs and calls are made.

d. Contacts with other species: Make a record of the reactions of the animals studied to other species (both predator and non predator).

3. With the use of the behavior data sheet provided, have the people observe the behavior of animals for a period of about one hour noting the number of times a particular behavior was exhibited and the amount of time used for each behavior observed.
4. Ask people to interpret their observations and share what they have learned about animal behavior.
5. If time permits, a comparison of behavior in wild and captive situations should prove worthwhile.

BEHAVIOR DATA SHEET

Type of Behavior	No. Times Observed	Time Spent in Behavior
Maintenance		
Stretching		
Grooming		
Wallowing		
Shaking		
Rubbing		
Scratching		
Sun bathing		
Sleeping		
Locomotion		
Drinking		
Feeding		
Display		
Attack		
Escape		
Pair Formation		

Type of Behavior	No. Times Observed	Time Spent in Behavior
Voice		
Territorial calls		
Attraction calls		
Distress calls		
Interspecific contacts		
Predators		
Non-predators		

WEATHER FORECASTING

Materials:

1. Notebook and pencil

Objectives:

1. People will learn how to tell the direction of the wind and recognize the different types of clouds.
2. People will learn how to forecast the weather.

Procedure:

1. Have people keep a set of daily records over a period of time (several months).
2. All observations should be made at approximately the same time each day (10:00 - 12:00 noon is best).
3. Use the table provided for making forecasts from your observations.
4. Keep a tally of the accuracy of their forecasts. What is the total percent of accurate forecasts? What is the percent accuracy for the various combinations of clouds and winds? What is the percent accuracy for the different seasons of the year?
5. Study books on weather and take the class to the local Weather Bureau or have someone from the Weather Bureau come and talk to the class.
6. With your additional information on weather and weather forecasting, refine your procedures and once again make forecasts. How do your forecasts compare with those you made previously? How do your forecasts compare with those reported by the local news media?
7. Questions for further thought and research:
   a. How do different weather conditions affect you?
   b. Of what value is it to be able to forecast the weather?
   c. What are some of the advantages and disadvantages of controlling the weather if we could do so?

Note: The U.S. Weather Bureau has a teacher's packet which contains a good set of cloud pictures. If you are or any of your people are interested in photography, a personal set of slides and/or photographs would be very useful (be sure to use a haze filter).

Forecasting Weather by Wind Direction and Sky Conditions

Summer - May to October

Clear sky (less than 1/4 sky covered by cloud)

Wind -	Calm, light, or west:	Fair weather
	Northwest:	" "
	North:	Fine and cool
	Northeast:	Increasing cloudiness
	East:	" "
	Southeast:	Cloudy, possible showers
	South:	Fair weather
	Southwest:	Fair and warmer

Cirrus (Very high cloud in wisps (mares' tails), or milky sheets, often showing ring around the sun or moon.)

Wind -	Calm, light, or west:	Fair weather
	Northwest:	" "
	North	" "
	Northeast:	Increasing cloudiness
	East:	" "
	Southeast:	Increasing cloudiness, then showers
	South:	" " " "
	Southwest:	Cloudy, possible showers

Altocumulus (Medium high cloud sheet in regularly spaced globules or bands, occasionally obscures the sun.)

Wind -	Calm, light, or west:	Little change
	Northwest:	Clearing and cooler
	North:	Little change
	Northeast:	Cloudy, possible showers
	East:	" " "
	Southeast:	Stormy
	South:	Showery and warmer
	Southeast:	Showery

Altostratus (Medium high cloud, flat gray, in one or more layers.) If sun is visible or it looks blurred, rain or snow may fall.

Wind -	Calm, light, or west:	Possible showers, then clearing
	Northwest:	Clearing
	North:	Little change
	Northeast:	Unsettled
	East:	"
	Southeast:	Stormy
	South	Showery
	Southwest:	"

Summer cont'd - May to October

Nimbus (Low, heavy, dark, ragged cloud from which continuous rain or snow falls.)

Wind -		
	Calm, light, or west:	Showery, then clearing
	Northwest:	" " "
	North:	Slow improvement
	Northeast:	Stormy, then slow improvement
	East:	Stormy, then showery
	Southeast:	Stormy
	South:	Slow improvement
	Southwest:	Showery then clearing

Cumulus (Cauliflower-shaped shower cloud with dark, flat base. Large formation may produce thunderstorm.)

Wind -		
	Calm, light or west:	Possible showers
	Northwest:	Clearing
	North	Clearing and cool
	Northeast:	Showery
	East:	Increasing cloudiness
	Southeast:	Possible thundershowers
	South	Thundershowers
	Southwest:	Showers and cooler

Stratocumulus (Low white or gray cloud, ranging from patches to completely cloudy.)

Wind -		
	Calm, light, or west:	Clearing
	Northwest:	Clearing, cooler, often windy
	North:	Clearing and cool
	Northeast:	Unsettled
	East:	Little change, then stormy
	Southeast:	Little change
	South:	Showery
	Southwest:	Showery

Winter - October to May

Clear sky

Wind -		
	Calm, light, or west:	Little change
	Northwest:	Fair and cold
	North:	" " "
	Northeast:	Fair with increasing clouds
	East:	Little change
	Southeast:	Increasing clouds then warmer
	South:	Increasing cloudiness
	Southwest:	Fair weather

Cirrus

Wind -		
	Calm, light, or west:	Fair weather
	Northwest:	" "
	North:	Fair and cold
	Northeast:	Little change
	East:	Increasing cloudiness, then warmer
	Southeast:	" " " "
	South:	" " " "
	Southwest:	" " " "

Altocumulus

Wind -		
Calm, light, or west:	Little change
Northwest:	Clearing and colder
North:	" " "
Northeast:	Unseattled
East:	Increasing clouds then stormy
Southeast:	" " " "
South:	Increasing clouds then showery
Southwest:	Showery then improving

Altostratus

Wind -	
Calm, light, or west:	Possible showers then clearing
Northwest:	Clearing and colder
North:	Slow improvement then colder
Northeast:	Unsettled
East:	Increasing clouds then stormy
Southeast:	Stormy
South:	"
Southwest:	Little change then showery

Nimbus

Wind -	
Calm, light, or west:	Showers then clearing and colder
Northwest:	" " " " "
North:	Slow improvement and colder
Northeast:	Stormy
East:	"
Southeast:	"
South:	Stormy then showery and clearing
Southwest:	Stormy then slow improvement

Cumulus

Wind -	
Calm, light, or west:	Showers then clearing and colder
Northwest:	Clearing, colder, often windy
North:	Clearing and colder
Northeast:	Showery
East:	"
Southeast:	Showery and warmer
South:	Warmer, possible showers
Southwest:	Possible showers

Stratocumulus

Wind -	
Calm, light, or west:	Showery
Northwest:	Clearing, colder, often windy
North:	Cloudy and colder
Northeast:	Cloudy, showery and cold
East:	Stormy
Southeast:	"
South:	Stormy and warmer
Southwest:	Stormy

Microclimates

Materials:

1. Laboratory thermometer (2)
2. Meter stick
3. Pencil and notebook
4. Relative humidity table (see appendix)

Objectives:

1. People will become aware of the existence of microclimates in the environment.
2. People will learn how to measure relative humidity.

Procedure:

1. Obtain two laboratory thermometers for each group. Wrap the tip of one with wet gauze or cloth (wet bulb thermometer).
2. Take the class outside and make temperature and relative humidity measurements on the south and north sides of the school building in the following places:
    a. Beneath the surface of the ground.
    b. At the ground surface.
    c. At 10 cm. increments from the surface of the ground to two meters above the ground.
    d. In the middle and outside of a tree, shrub, bunch of grass, etc.

Further experiences:

1. Why is the wet bulb reading lower than the dry bulb reading?
2. Design an exercise to investigate the microclimates within the classroom and school building.
3. How do microclimates affect you?

Air Pollution

Materials:

1. Glass microscope slides
2. Compound microscope
3. Vaseline
4. String
5. Masking tape

Objectives:

1. People will become aware of certain air pollutants in the air they breathe.
2. People will see how the quantity of certain air pollutants varies from one place to another and from one time to another.

Procedure:

1. Obtain glass microscope slides and attach a 12-inch piece of string to one end with the use of masking tape.
2. Coat one side of each slide with a relatively uniform layer of Vaseline.
3. Give each student at least two slides to be hung (one inside and one outside his home) for a period of three days.
4. Bring the slides to class and examine them for air pollutants. Compare (qualitatively and quantitatively) the results from different locations.

Further Experiences:

1. What other types of air pollutants exist in your air?
2. What are the primary sources of air pollution in Pueblo?
3. What is being done to solve Pueblo's air pollution problems?
4. What can you and your family do to help solve Pueblo's air pollution problems?

Water Conservation

Materials: To be creatively supplied by the student

Objectives:

1. People will become aware of the volume and cost of water used in activities of their daily lives.
2. People will learn what they can do to use water more wisely.

Procedure:

1. Ask each person to locate a leaking water faucet (in their home, at school, etc.).
2. Give them the task of determining the volume of water which is being wasted per month and the cost of this waste.
3. As part of this learning experience, let people think of their own methods, materials and sources of information to solve this problem.

Further Experiences:

1. How much water is being used by you and your family for: flushing toilets, washing and rinsing clothes and dishes, taking baths and showers, watering the lawn, drinking and cooking, etc.
   How much are these uses of water costing you or your family per month? In what ways could you cut down on your use of water? What amount of money would this save you?
2. How much water is required to produce: a ton of steel, a loaf of bread, a yard of fabric, a glass of your favorite beverage, etc.?

Forest Management

Materials:

1. Tree-height stick
2. Tree-diameter tape
3. Increment borer (optional)

Objectives:

1. People will learn how to use basic mathematics as a tool for managing our forest resources.

2. People will learn some basic concepts and terminology used in forest management.

Procedure:

1. Have people make tree-height sticks and tree-diameter tapes.
2. Show how trees are aged and let students determine the ages of a few trees (cross sections of trees or an increment borer will be needed).
3. Go to a forest or one of the city parks which has an old stand of trees.
4. Follow the instructions given: (Source: U. S. Forest Service pamphlets on Forest Conservation):
    a. Study of annual rings. Growth rate is such an important factor in determining whether a tree should be cut, and as an indicator of the "tree-growing capacity" of a site that it deserves some attention.

       Find the stump of a tree, or the end of a log, cut recently enough to show annual rings plainly -- or have a cross section of stump or log brought to the classroom, sand the surface, and varnish it for future use. Nearly any of the pines, oaks, elms, or ashes provide good examples since the rings are distinct. What causes the appearance of "rings"?

       Determine the age of the tree by counting the annual rings.

       How many rings in the last inch of radius? Phrased more meaningfully: How many years were required for the tree to grow its last 2 inches in diameter?

       At what period in its growth did the tree grow fastest? Slowest?

       Name some national events that occurred when this tree was about one year old.

If possible, compare rings in a fast-growing tree with rings in a slow-growing tree. Interesting examples are trees of about the same age but with much difference in diameter, or some diameter and much difference in age.

b. Become familiar with some units of measurements used in forest conservation.

1. Chain

A common unit of distance in conservation work is the surveyor's "chain" of 66 feet. There are 80 chains in a mile. One reason a chain is convenient to use is that 10 square chains equal one acre; if the area of a tract of land can be determined in square chains, it is only necessary to point off one decimal place, equivalent to dividing by 10, in order to obtain "acres."

A rapid and fairly accurate method of obtaining distances, and thus area, is by pacing. Measure off 66 feet on fairly level ground, driving a stake at each terminus to mark the "course." Walk from one stake to the other taking a normal stride and looking ahead, not at the ground. Step off the left foot forward, and count one pace every time the right foot strikes the ground. (one "pace" is 2 steps). Write down the number of paces. Turn around, walk back to the first stake and, using the average number of paces obtained in the 2 trials, make note of the number of paces you take per chain. (It is well to verify this on a measured course once in a while as one's length-of-pace may change).

How many chains across your school grounds?

2. Acre

How many adults have even an approximate conception of the size of an acre, the commonest unit of land area? An acre contains 43,560 square feet, but this is a cumbersome figure to deal with. More conveniently, an acre is equal to 10 square chains (see "1"). It may be a rectangle 5 chains x 2 chains, of any other dimensions whose product will equal 10 square chains.

Lay out a one-acre plot

Select convenient dimensions to fit the ground, and using the method described in "1", pace off the required number of chains on each side of a rectangle one acre in size. Drive stakes, or use convenient trees or other objects for corners. Let pupils discuss and "absorb" the size of this one-acre area. Mention value: Good farm land might be $200 an acre, poor farm land $30 an acre.

Now select the block in which the school is located (use other convenient boundary unit at rural schools) and let pupils estimate the number of acres it contains. (Or use the town "square", school forest, city park boundaries any unit readily identified).

Write down these estimates. Let pupils pace the boundaries to obtain dimensions in chains; multiply the length times width, then point off one place, thus obtaining the result in acres. (Example -- 9 chains x 3 chains equals 27 square chains equals 2.7 acres). Whose estimate was closest?

3. Acre-foot

This is the common unit for "amount of water" either as in a lake, or having fallen as rain. It refers to the number of acres that would be covered by the water to a depth of one foot. Acre-foot is also used in connection with soil. A convenient time for becoming familiar with this unit is during the study of the "acre". In fact, the following can be done at the time the acre is laid out in "2".

Have pupils space themselves out evenly around the 4 sides of the acre tract that has been paced off. They are familiar with a one-foot ruler; ask them all to place a hand one foot above the ground. By looking around the area circumscribed they can now visualize "one acre-foot." They know their own heights; ask them all to place a hand 5 feet above the ground. This will give them an idea of "5 acre-feet."

4. Cord

The cord is a common unit of measurement of wood; it contains 128 cubic feet. The standard cord is the wood and air space in a pile of 4-feet length stacked 4 feet high and 8 feet long. Pulpwood and fuelwood are measured in cords. If you have a school forest, or are located near a woodland of any kind, try to arrange for the cutting and piling there of a cord of wood for demonstration purposes. As a substitute, drive 4 stakes to form the dimensions of a cord, (or place 4-foot marks on a wall and drive 2 stakes 8 feet away etc.); use string to identify the top dimensions.

Mention value: Pulpwood might be worth $12 to $25 per cord loaded on a railroad car depending upon the species and other factors; fuelwood might be worth $10 a cord in a forest area, $50 a cord sold in small amounts for fireplaces in cities.

How many cords of wood could be piled in your schoolroom?

5. Board foot

The common unit of measure for lumber is the board foot, a piece of wood one foot long, one foot wide, and one inch thick. A board foot contains 144 cubic inches, or 1/12 cubic foot. Obtain a piece of lumber 6 inches wide, 2 feet long, and one inch thick. Cut it in two and nail the pieces together to form a piece one foot long, 6 inches wide, and 2 inches thick. (Boards 12 inches wide may be difficult to find.) Show this to the class. It contains one board foot. Pass around a "two by four" 1 1/2 feet long. This also contains one board foot. (However, rough sawed lumber is usually somewhat scanty in width and thickness, planed lumber more so.)

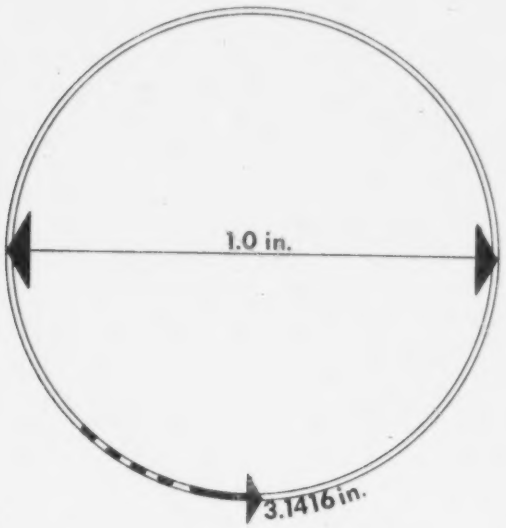
How many board feet would be needed to cover the floor of your schoolroom with lumber (flooring), 1/2 inch thick?

c. Learn to measure diameter and height of trees. This exercise makes use of arithmetic and simple geometry. It demonstrates how to measure tree diameter and total tree height.

1. Make diameter tapes. Students work in "crews" of 3 members each. Each crew begins by making one tape for measuring diameters of trees: Prepare a piece of tough paper or flexible cardstick 1/2 inch wide and 5 feet long if trees to be measured will be as large as 20 inches in diameter, 10 feet long if trees will be as large as 36 inches in diameter. Strips may be glued together for proper length.

Begin 2 inches from one end of the tape. Make a mark with black ink. Label it "0". Circumference always equals diameter times 3.1416 (called "pi"). Measure 3.14 inches (3-1/8 is close enough) from the "0" mark and make another mark. Label it"1". Continue for the length of the tape as in the diagram (that follows) with all marks 3-1/8 inches apart:

Relation of diameter to circumference



(3.14 in.)	0	1	2		

2. Using the diameter tape. Diameters of trees are measured at a point 4-1/2 feet above the ground. This is approximately "breast height" for an adult, so the term used by foresters is "diameter breast high," abbreviated "d.b.h." The tape constructed in step "1" is merely passed around the tree to be measured, at a point 4-1/2 feet above average ground level, and the nearest number which appears over the zero reference point is the diameter in inches. Keep tape rolled and fastened with paper clip or rubber band when not in use.

Tree-height stick

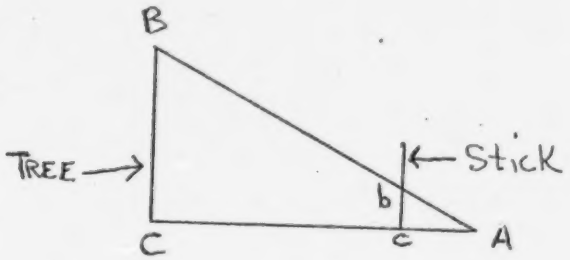
(3.14 in.)	1/2	1	

Make tree-height sticks. The same 3 people now work together to make one stick per crew for measuring heights of trees. On one side of a yardstick, fasten a strip of one-inch masking tape for the length of the stick (or glue or cement a strip of tough paper or cardstock to the yardstick). Begin at one end as "zero" and make marks 3-1/4 inches apart with black ink for the length of the stick, labelling the first.

"1/2," the second "1," the third "1-1/2," and so on.

4. Using the tree-height stick. First, each person in turn determines his normal arm-reach as follows: Grasp the tree-height stick a few inches from the zero end, and with fingers at eye level, hold the stick vertically in a comfortable arm position (out-stretched), while a partner measures the horizontal distance from eye to stick. Keep this distance at 23, 24, or 25 inches, whichever seems most natural. Maintain this distance while measuring trees; write it down for reference if necessary. Arm reach does not have to be measured each time a tree is measured, but it should be checked occasionally.

Using the pacing method described in the second paragraph of part "1," Activity "B", pace out from the tree whose height is to be measured for a distance of 61 feet if arm reach is 25 inches, 59 feet if it is 24 inches, and 57 feet if it is 23 inches. Make written note of this ground distance for reference. Pace in any direction, so long as the top of the tree to be measured can be easily seen from the stopping point. (The reason for the variable distances is that we are using the principle of similar triangles and $\frac{Ac}{AC}=\frac{bc}{BC}$.



At 61, 59, or 57 feet, stop, face the tree to be measured. Hold the stick vertically at arm's reach of 23, 24, or 25 inches as determined previously. Sight across the bottom end of the stick ("zero point") to the base of the tree at ground level. Without moving the stick, KEEP IT VERTICAL and sight to the top of the tree. Line of sight will of course intersect the stick also. Read off the figure on the stick nearest the line of sight to top of tree. This figure is the number of 16-foot lengths in the tree: "2-1/2" means 2-1/2 16-foot length, or a total height of 40 feet. (16 feet is the standard log-length used in estimating timber volume.)

5. Measure some trees.

Instructor's responsibility: The instructor divides by 3 the total number of trees he has selected to be measured and, before the work starts, tells the crews how many trees are to be measured before crew-member jobs are rotated; in this way, each person performs each of the 3 tasks -- recorder, diameter-measurer, and height-measurer. The instructor places light-colored cardboard tags at least 3 x 3 inches in size on the trees to be measured, at about eye level, labelling each tag with a plain number for easy identification. All tags face in the same direction for the sake of visibility.

The crews of 3 members each now proceed to measure the trees. Their duties:

(a) Recorder: Make a tally sheet by preparing a sheet of paper as follows.

Tree No.	d.b.h.	height
1		
2		
3		
etc.		

He enters numbers in the d.b.h. and height columns as they are called off to him.

(b) Diameter-measurer: Selects the order in which trees are measured, making it possible for the crews to keep out of each other's way as trees do not have to be taken in chronological order of numbering. Measures diameters with the diameter tape and calls off diameter to the nearest inch, to the recorder. (See "2" for method of use.)

(c) Height-measurer: As soon as the diameter-measurer has selected the tree, the height measurer begins pacing off the proper distance. He uses his stick and calls the height to the recorder. (See last 2 paragraphs of "4" for method of use.)

The instructor travels from crew to crew and by checking measurements as they are made, keeps a personal tally-sheet record of correct measurements which includes all the trees. After the work is completed, crews are assembled, and measurements are verified against the instructor's record. Any questionable results should be checked by remeasurement so that everyone is satisfied. Some sort of appropriate honor or prize may be awarded the crew showing the most accurate results. The instructor should make clear the functional value of the activity, pointing out how tree measurements show timber volume on a tract, the basis for sales of standing timber to logging operators.

What is the tallest tree on the school grounds? On the school forest? How many trees in the school block are over 40 feet tall? What tree on the school grounds (or in your town, etc.) has the largest diameter? How many trees on the school grounds are sawtimber size (over 12 inches d.b.h.)?

STANDING WATERS

Materials:

1. pH paper
2. Laboratory thermometer
3. Dissolved oxygen reagents
4. BOD bottles
5. Small Seine
6. Tea strainers or sieves
7. Plankton net (make one out of old "panty-hose")

Objectives

1. People will become aware of the physico-chemical environment in a standing water ecosystem.
2. People will become aware of the basic food chain (plankton, insects, fish) in a standing water ecosystem.

Procedure:

1. Collect water samples from one depth and measure the pH, temperature and dissolved oxygen of the water.
2. Collect plankton samples by either towing the net or passing a known quantity of water through it.
3. Collect invertebrates from submerged plants, rocks, logs, etc. and by sifting sediments with a strainer or sieve.
4. Seine the shallow areas for larger invertebrates and vertebrates.
5. Identify the organisms collected to the best of your ability.

Further Experience:

1. Compare the standing water community with the flowing water community.
2. Investigate vertical stratification in the standing water body by repeating your sampling at three different depths.
3. Investigate horizontal stratification in the standing water body by repeating your sampling at different locations (north, south, east, west).
4. Measure the primary productivity of a standing water ecosystem (see exercise on primary productivity).
5. Compare two different types of standing water bodies.

Flowing Waters

Materials:

1. ph paper
2. Laboratory thermometer
3. Cork float
4. Dissolved oxygen reagent
5. BOD Bottle
6. 50-ft. piece of string
7. Wrist watch with second hand or stopwatch
8. Yard or meter stick
9. Dish pan
10. Small seine
11. Window screen (4 ft.)

Objectives:

1. People will become aware of the physico-chemical environment in a flowing water ecosystem.
2. People will become aware of the basic food chain (algae, insects, fish) in a flowing water ecosystem.

Procedure:

1. Have people measure off and mark a 50-ft. section of the stream. Determine the average width and depth of the stream in the chosen section. Use the average of 10 depth measurements across the stream.
2. Have one person drop a cork float in the water in the middle of the stream and at the beginning of the chosen section. Have a second person retrieve the cork float at the end of the chosen section and a third person record the time lapsed while the cork float was traversing the chosen section. The velocity of the stream, just measured, should be recorded in feet per second.
3. Make a note as to whether the bottom of the stream is:
   rough and composed of loose rocks and coarse gravel
   or smooth and composed of such materials as sand, hardpan or bedrock.
4. Calculate the discharge or volume of flow with the following formula:

$$V=\frac{wdal}{t}$$

Where:

v= volume of flow in cubic feet per second
w= average width in feet of channel section tested
d= average depth in feet
a= constant
l= length in feet of channel section tested
t= average time in seconds required for cork to traverse channel section

The value of a depends upon the nature of the bottom. If the bottom is rough and composed of loose rocks and coarse gravel, a has a value of 0.8; if smooth and composed of such material as sand, hard pan or bedrock, a is given a value of 0.9.

5. Measure the ph, temperature and dissolved oxygen concentration of the water.
6. Collect algae and aquatic insects from the bottom of the stream by picking them from rocks, logs, etc. and by screening (disturb the bottom above the screen and let the flow of the stream carry organisms into it). Place the organisms in a dish pan and identify them as best you can noting adaptations they possess which enable them to survive in this environment.
7. Seine the stream (seine downstream) for fish, crayfish and other larger animals.

Further experiences:

1. Compare the flowing water community with the standing water community.
2. Compare a swift section of a stream with a slow section of a stream.
3. Compare a large stream with a small stream.
4. Compare a "clean" stream with a "polluted" stream.

A. Materials:

1. 2 "light" BOD bottles
2. 1 "dark" BOD bottle
3. Dissolved oxygen reagents for Winkler test
4. Thermometer
5. 4 10-ml pipettes
6. 1 250 ml graduated cylinder
7. 1 250 ml flask
8. 1 25 ml burette

B. Objectives:

1. People will become aware of the processes of photosynthesis and respiration as they occur in aquatic systems.

C. Procedure:

The "light" and "dark bottle oxygen technique for measuring primary productivity is commonly employed in aquatic environments. This method is based on the assumption that the amount of oxygen produced by plants per unit time is proportional to gross primary productivity. Net primary productivity is the difference between gross primary productivity and respiration. Two bottles containing a given concentration of phytoplankton are suspended in situ at the place and depth from which they were taken. One bottle (the "dark" bottle) is covered with aluminum foil or black tape to keep out the light; the other bottle (the "light" bottle) is clear. In the "light" bottle, oxygen is produced by photosynthesis, and some oxygen is consumed in respiration. In the "dark" bottle only respiration is taking place. At the beginning of the experiment, and after a given period of exposure, the dissolved oxygen concentration of the water in the bottles is determined by the Winkler method (see Appendix).

The Field Procedure:

1. Fill two "light" bottles and one "dark" bottle with water taken from just below the surface of the lentic habitat selected.
2. Suspend one "dark" bottle and one "light" bottle together at the place and depth from which the samples were taken (replace stoppers).
3. Run a Winkler test for dissolved oxygen immediately on the other "light" bottle sample.
4. Allow the samples suspended in the lentic habitat to be exposed for a period of six "light" hours (from dawn to six hours later).
5. After the six-hour exposure time, remove the bottles from the lentic habitat and run a Winkler test for dissolved oxygen on each sample immediately.

Laboratory Procedure:

1. If a large (10 gal. and up) aquarium is available, the same procedures as described for use in the field can be used.
2. Equal amounts of floating water plants (elodea, Ceratophyllum, etc.) can be placed in the bottles to greatly increase the rates of photosynthesis and respiration.

Calculation of results: (example)

1. Dissolved O_2 after exposure ("light" bottle 11.1 mg/l O_2
   Dissolved O_2 before exposure ("light" bottle) -7.2 mg/l O_2
   Net primary productivity 3.2 mg/l O_2

2. Dissolved O_2 before exposure("light" bottle) 7.2 mg/l O_2
   Dissolved O_2 after exposure ("dark" bottle) -2.6 mg/l O_2
   Oxygen consumed (respiration) 4.6 mg/l O_2

3. Net Primary productivity 3.2 mg/l O_2
   Oxygen consumed (respiration) +4.6 mg/l O_2
   Gross primary productivity 7.8 mg/l O_2

D. Further investigations:

1. Bottles can be wrapped with different colors of plastic or cellophane to determine the effect of different wave lengths of light on photosynthesis.
2. Small aquatic animals can be placed in bottles to determine their respiration rates.
3. Detergent, insecticide, fertilizer, etc. can be introduced into bottles to show their effect on photosyntheses and/or respiration.

Colorado Life Zones

A. Materials

1. None

B. Objectives:

1. People will become aware of the five Colorado life zones and some of the ecological parameters which characterize the different zones.
2. People will become aware of the distributional patterns of different organisms and the major factors which control the distribution and abundance of organisms.

C. Procedure:

1. Have the people read the descriptions of the five different life zones found in Colorado.
2. Go on a field trip from Pueblo to Greenhorn Mountain summit. Stops at Pueblo (Plains Zone), Beulah (Foothills Zone), Ophir Creek Road (Montane Zone), Greenhorn Road (Subalpine Zone), and Greenhorn Summit (Alpine Zone) will cover the five life zones in Colorado.
3. A field trip to the Denver Museum of Natural History to observe the Ecology Hall with its representations of the Colorado Life Zones would be second best, but worthwhile.

THE PLAINS LIFE ZONE

The Plains Life Zone ranges in altitude from 3,500 to 5,500 feet and is an area of scant precipitation. The mean annual precipitation in the Pueblo area is approximately 11.2 inches. On this basis the Plains Life Zone may be classified as semi-arid in this area. Most of the plants are restricted to those species which are tolerant to long periods of drought. The dominant vegetation type of the zone is the grasses, particularly the short grasses such as the grama and buffalo grasses. Because of the dominance of short grasses and the absence of most tree species, the Plains Life Zone may be considered Short Grass Steppe. Members of the composite family (Compositae) are also abundant. In the wetter areas, sedges and rushes may largely replace the grasses, and in very dry or impoverished soils certain hardy species of grasses, yucca and several species of cactus may be the only plants able to persist.

The first plant association you will observe will be one comprised chiefly of short grasses, prickly pear cactus, yucca, rabbit bush and sagebrush. Wherever you come near a stream you will observe an association consisting of broad-leaf cottonwood, willows and salt cedars which follow the course of the stream rather closely. As you move toward the mountains (thus attain higher altitudes) you will first observe many fields in which the tree cactus is quite abundant

and then you will observe a very distinct Pinon-Juniper association.

The dominant animal forms in relation to numbers are the invertebrates: spiders, insects (particularly of the Orthoptera, Hemiptera and Hymenoptera). A few Isopods may be observed by turning over rocks, but be careful, as a scorpion or rattlesnake may be lurking underneath. Among the vertebrates, the birds will be probably most conspicuous, especially during the breeding season. Horned larks, mountain bluebirds and western meadowlarks should be encountered. You might see a scaled quail if you really keep your eyes open and are alert. Sparrow hawks and some of the larger hawks should be observed. The mammals should be represented by jackrabbits, cottontail rabbits, antelope, deer, skunks, many small rodents and several other less conspicuous or less abundant species. The only amphibian which you would expect to find is the Barred Tiger Salamander. Several species of lizards and skunks can be found and some of the snakes you might encounter are: the prairie rattlesnake, the bull snake, the garter snake, and the red racer.

THE FOOTHILLS LIFE ZONE

The foothills or Transition Life Zone ranges in altitude from 5,500 to 8,000 feet and has a total annual rainfall greater than that in the Plains Life Zone. Unlike the Plains Life Zone, the broken character of the Foothills Life Zone offers protection from storms. Some of the characteristic tree species are: Ponderosa Pine, Scrub Oak, White Fir, Douglas Fir, Cottonwood, and Rocky Mountain Maple.

The conspicuous topographic break between the plains and foothills is accompanied by an equally striking change in vegetation, from grassland to forest. In this area of Colorado the plains and the foothills are separated by an ecotone. The grasslands that dominate the great plains are broken by groves of trees only in isolated sites of unusual soil conditions and in strips along river valleys. Grasses also dominate many of the lower mesas and foothills slopes, but trees become dominant on the higher mesas and foothills slopes at the base of the mountains. The rocky backbone of the foothills usually is occupied by a band of Ponderosa Pine trees, while grasses cover the deeper and finer soil in the lowlands between the hills. At progressively higher elevations, between about 5,600 and 6,000 feet, grasses become less abundant, and trees become more common. Within this region, regional climate is suitable for both grasses and trees; differences in soil or topography, or both, determine which of the two vegetation types will occupy a given locality. Fine, deep soil supports grassland; coarse, rocky soil and even fractured rock outcrops support pine. Stands of Ponderosa Pine on south-facing slopes are more sparse than the denser growths on north-facing slopes. North-facing slopes may also contain Douglas Fir interspersed among the Ponderosa Pine. Cottonwood trees (Populus sargentii) similar to those on river bottoms and in the plains extend up into the mountains along rivers, but the species change with increase in altitude first to Populus acuminata and then to Populus angustifolia.

Forest is the dominant vegetation from about 6,000 feet to tree-limit at approximately 11,400 feet. Between elevations of approximately 6,00 and 7,700 feet, Ponderosa Pine, Douglas Fir, and White Fir are the conspicuous trees, Ponderosa Pine being dominant on southern exposures and a mixture of White Fir and Douglas Fir dominant on southern exposures and a mixture of White Fir and Douglas Fir dominating northern exposures. Extensive dry meadows are still common in this area, especially on south-facing slopes. Douglas Fir becomes more and more common on the southern exposures with increasing altitude. From elevations of about 8,000 to 9,000 feet, the same tree species are common, but individual communities have a greater density. Stands on southern exposures are dominated by a mixture of Douglas Fir and Ponderosa Pine. Northern exposures may have a clear dominance of the Douglas Fir and White Fir although Ponderosa Pine is rarely absent. Meadows are less frequent than at the lower elevations.

Signs of deer and many other smaller mammals should be much more abundant than on the plains. Birds should be abundant. Snakes and lizards are common in this area but it may be too cold for them to be very active. Among the most common invertebrates are the Coleoptera and the Arachnida.

THE MONTANE LIFE ZONE

The Montane Life Zone is the zone usually extending from 8,000 to 10,000 feet and having an annual rainfall more than twice that of the Plains Life Zone. Vegetation is quite abundant. The chief adverse conditions to which the biota is subjected are: the short season from the spring thaw to the fall freeze, and more tree shade and competition from roots. This is the best zone for the state flower, the Columbine. Some of the characteristic plant associations are: Lodgepole Pin and Quaking Aspen; Dog Birch and Shrubby Cinquefoil; Englemann Spruce and Alpine Fir; and Douglas Fir and Ponderosa Pine.

This zone has also been called the Canadian Zone and the Douglas Fir Zone. It lies between the Foothills Life Zone and the Subalpine Life Zone. The Montane Zone and the Foothills Zone are more closely related than most pairs of adjacent regions. They differ very little in many characteristics, but some features, such as the role of the Douglas Fir, are distinctive and require that the two zones be kept separate. Valleys in the upper altitudes are broad as a result of glaciation, but they often become very narrow at lower altitudes. Glacial moraines occur in some of the wider valleys and in some areas, small lakes and ponds are common.

From 8,000 to 9,000 feet, many of the tree species found in the Foothills Zone can be also found in the Montane Zone, but the individual species usually have a greater density. Stands on southern slopes are dominated by a mixture of Douglas Fir and Ponderosa Pine with the former being the most abundant. Northern exposures may have a clear dominance of the Douglas Fir, although Ponderosa Pine is rarely absent. Meadows are less frequent than at lower elevations. Stands of Lodgepole Pine and Aspen occur above the altitudinal limits of the Ponderosa Pine and Douglas Fir but become less common above approximately 10,000 feet. They become common on north-facing slopes around 8,500 feet elevation and on ridge tops and south-facing slopes

a few hundred feet higher. The common Juniper should be quite common.

Soil profiles are poorly developed on ridge tops and upper slopes. The deepest soil and best-developed profiles occur where small tributary valleys enter larger valleys. The parent material here has been transported by water through runoff and slow seep. Many profiles lack a conspicuous horizon of clay concentration (horizon B). The soils are sandy loams or loamy sands and are related to the grey-brown podzolic soils. Soil water content is low most of the year, remaining close to the wilting percentage most of the fall and winter. Soil ice is rare, but it does occur at the surface for short intervals during the winter.

Two tree parasites, Black Hills Beetle and Dwarf Mistletoe have damaged and often killed many Ponderosa Pine trees in both the Foothills and the Montane Zones. Beavers are quite active along the small numerous streams found at the bottom of the valleys.

Evidence of deer should be abundant in the zone and you should encounter some Stellar Jays and Juncos. Gophers are quite common in this zone. A few lizards and snakes will probably be found if it isn't too cold.

THE SUBALPINE LIFE ZONE

From timberline downward to about 10,000 feet, the climax forest is made up largely of Englemann Spruce and Alpine Fir, which grow in dense stands (so-called "black timber"). The spruce is larger, longer-lived and the more abundant tree. Subordinate species vary far more than do the dominants. The transition from the subalpine forest to the alpine tundra is usually gradual with a thinning-out of trees, which near their upper limits commonly have the dwarfed and distorted form known as Krummholz. Characteristic of timber-line are several trees that cannot survive in tundra above and cannot compete with climax species below, where they are only found on dry and wind swept ridges. Bristlecone Pine occupies this position in the southern rockies.

Heaviest snowfall is in this life zone. The slow-melting snow ensures a continuing supply of moisture and allows a luxuriant vegetation to develop. The temperatures are cold in winter and the growing season is short. In Colorado, most of our "high" lakes are found near the upper part of this life zone.

THE ALPINE LIFE ZONE

When climate changed and terminated the last glacial period, biota similar to that in the modern tundra must have followed the ice as it receded northward. This left only high peaks and ridges (such as we have in the Colorado Rockies) where tundra populations could survive as relicts. The relict biota obviously belongs to the Tundra Biome because of the similar morphology and the duplication of characteristics genera as well as many species.

The alpine tundra is located above timberline (approximately 11,400 feet in this part of Colorado). It is one of the most delicate and easily damaged ecosystems. Vegetation is low, dwarfed and matlike, and includes a high proportion of grasses and sedges. Even the woody plants, including the willows and birches, are usually prostrate. The herbs are mostly perennial and of a rosette type, producing relatively large flowers often brightly colored. Mosses and lichens may grow anywhere and in favorable habits, form a thick carpet with the low-growing herbs. Species diversity of communities is relatively low in comparison with the biota of the other life zones and is due to the severe environmental stress of the environment.

The growing season is short and temperatures are relatively low. Permafrost in the soil and its depth of thawing in summer (about 1-8 feet in Colorado) produce severe stresses on the biota as does the extreme instability of the soil, related to frost action. Light is intense and relatively high in ultraviolet rays in comparison with life zones at lower elevations. Precipitation is largely in the form of snow and varies greatly. Local marked differences in vegetation are commonly related to minor variations in topography and the differences produced in drainage and retention of snow. High wind velocities, low oxygen concentration and low barometric pressure are other environmental features of the Alpine Life Zone.

Common herbaceous vascular plants include: grasses, sedges, saxifrages, rushes, legumes, sedums, and fireweeds. Important shrubs include willows, alder, cranberry, birches, and leatherleaf.

Many migratory species of birds frequent the alpine tundra in the summer months. Permanent animal residents have had to adapt to the long and extremely cold winters. The common pika, yellow-bellied marmot, and mountain sheep are characteristic mammals. Shrews, bears, coyotes, weasels, badgers, mice, wapiti and mule deer of the lower life zones range up into the alpine tundra during the summer months. Of birds, the white-tailed ptarmigan, water pipit, and gray-crowed rosy finch are characteristic and widely dispersed. In the Colorado Rockies, grasshoppers are among the most common invertebrates. Flies (Diptera) and spiders are also very common.

Environmental Problems

Materials: None

Objectives:

1. People will become aware of environmental problems which affect their lives.
2. People will become aware of some of the solutions to our environmental problems and understand some of the reasons we are not solving some of them.

Procedure:

1. Set up debates, panel discussions, mock hearings and/or give speeches on environmental problems.
2. Suggested topics:

Population control (international, national, state, local).

Birth control (contraception, abortion, Euthanasia).

Channelization of the Fountain and/or Arkansas Rivers.

Diverting water from the western slope to the eastern slope.

Land use legislation to control land development in Colorado.

Hunting and fishing in Colorado.

Creating wilderness areas in Colorado.

Building highways through existing wilderness areas in Colorado.

Cutting timber on National lands.

1976 Olympics in Colorado.

Mining oil shale in Colorado.

Underground exploration for fossil fuels in Colorado using nuclear devices.

Alaska oil pipeline.

Electric or steam vehicles for our cities.

Use of pesticides.

Chemical and biological warfare.

Nuclear energy.

Solar energy.

Weather modificaiton.

Off-the-road vehicles on public lands.

Organic foods.

Gravel mining along the Arkansas River.

Mass transit system for Pueblo.

The Pueblo Zoo.

The quality of Pueblo's water.

City-controlled solid waste collection, recycling and disposal.

Sign control ordinance for Pueblo.

Rezoning the Fountain River Floodplain to allow commercialization.

Laws regulating dogs, cats and other noxious pets.

Noise control ordinance for Pueblo.

Further Experiences:

1. Attend meetings at which environmental topics are being considered.
2. Write an ordinance designed to solve a local environmental problem.
3. Write legislators or government officials expressing your ideas and feelings about local environmental problems.
4. Write letters to the editor of the local newspapers expressing your views on environmental problems.

Identifying and Checking-out Assumptions

Materials: None

Objectives:

1. People will learn to identify and check-out assumptions underlying prevalent attitudes and values about the environment.
2. People will have the opportunity to evaluate their own assumptions and consider alternatives which may lead to new and different attitudes and values.

Procedure:

1. Type each statement in the appended list of "Environmental Lessons Being Taught Today" on one side of an index card. (one statement per card)
2. Divide your class up into groups of about four persons. Give each group about four statements and instruct them to first identify the assumptions underlying each statement. Next, have each group check out the validity of each assumption identified.
3. Bring all of the groups together and have them share their awarenesses with each other. An enthusiastic discussion will probably be experienced can be a source of motivation for further research and discussion.

Further experiences:

1. Conduct polls to become aware of how the attitudes of other people and groups compare with those of the class.
2. Invite persons from the community in and have a discussion.
3. Contact a speech teacher to help you set up debates on those attitudes and values which continue to be devisive.

Environmental Lessons Being Taught Today

1. Our solid waste problems will be solved if everyone quits being a litterbug.
2. Man derives his security and fulfillment in life from the accumulation of things and the symbols of things.
3. When something (like paper, automobiles, bottles, etc.) has been used, and served its purpose, it is considered waste.
4. Population growth is good, bigger families and communities are happier families and communities, and more people means more friends.
5. A couple should have as many children as they can afford.
6. Our population problems would be solved if the people on welfare didn't have such large families.
7. A child born in a communist country is more of a threat to the world's well-being than if he/she was born in this country.
8. The Asians won't starve, as long as I eat everything on my plate.
9. The sea, which accounts for three-fourths of our earth's surface area, is a vast reservoir for food, sufficient to meet the needs of the growing world population.
10. The problems which plague man have been, and will always be, solved by science and technology.
11. Only man has a right to the earth: other forms of life, while nice, are really unnecessary.
12. The damming and channelization of our rivers brings nothing but good: increases in agriculture, commerce and industry; expanded recreation and urban growth; and flood control.
13. The quality of life in a country can be assessed and measured by Gross National Product.
14. Using half of the world's resources to support our less than 7% of the world's population is okay because we are innately superior and this is God's "chosen land" and we are His "chosen people".
15. What is done to the environment in one place or nation has no effect on any other place or nation.
16. Man, unlike other forms of life, is not subject to the "laws" and processes which have made life possible on this planet.
17. If man were to structure his systems to simulate natural systems, he would use a linear model.
18. The words and symbols we create to represent people and things are, in reality, the people or things themselves.
19. Person one is person two: experience one is experience two; tree one is tree two; snake one is snake two; etc., etc., etc.
20. In natural systems (cell, individual, population, community, ecosystem), the whole is equal to the sum of its parts.
21. Sex is for procreation not recreation.
22. Dilution is the solution to pollution.
23. Pueblo's air pollution problem will be solved when industry cleans up their smokestacks.

24. God will decide how many people should inhabit the earth and He won't let us become overpopulated.
25. World peace and international cooperation can be achieved by threat and fear of brute force.
26. If every country were like the United States, the world would be a better place to live in.

Trash Can Be Beautiful

Collect trash from the playground and use the materials for art projects.

Sponsor poster contests for school and community benefit.

Make litter bugs - environmental buttons. This activity can be sponsored by the student council. They can be passed out to students, parents, or teachers, who create litter problems.

Make litter bags for each room, for cars and for homes. Use an environmental theme in the design.

Mix paints or dyes from natural materials.

Use natural materials as an art form. Use pieces of driftwood, etc.

Perform weaving activities using natural materials.

Design and make a costume (clothing) for a doll, using only natural materials.

Make crystals (salt, sugar, cream of Tartar, or purchase a crystal making set from a manufacturer.

Ecological concepts can be developed from children's literature. For example, books concerning seed life. Students can discuss needs of the seed as they extract these needs from the book. The same kinds of activities can be taken out of many books concerning a wide variety of subjects dealing with the environment.

Problems for The Senior Citizen or Adult

An awareness of Organic Gardening.

Identify native birds - build bird feeders and observe if changes in bird population commence with addition of feeders and a water source.

Take a trip to your local park or other area where there is a lot of plant life. Begin identifying plants and keeping a close look concerning their growth.

Visit your local school and offer your services for planting and helping to take care of plants. Work closely with students as they plant and work with plants.

Visit your immediate environment. How can you help create improvements?

Work closely with the local beautiful association. Can you be a resource to other organizations as they commence beautification activities?

Offer your assistance to local schools as a resource person for presenting talks and displays concerning environmental problems. What differences are there in comparison when you were a youngster?

Develop a local greenhouse for plant growth. Perhaps it could be a local community or school greenhouse using your skills to help develop and maintain plantlife.

Work closely with your local governmental representatives and discuss how your immediate environment can be improved.

A DREAM FOR TOMORROW

The citizens of your local community will raise money through community projects to hire high school and college youngsters to clean up areas that can be used for recreation, parks, wildlife habitats, etc. such as the Fountain River Project.

The local zoos will establish facilities to create an animal education center. Perhaps animals should be of local state habitat. Miniature habitats should be developed for exhibition of local animals such as lizards, snakes, different plant life - Informed individuals can develop history and perhaps tours can be given for local school groups.

Large businesses such as steel mills, etc. begin a beautification campaign to show what can be done. There is nothing like setting a good example.

Homebuilders and contractors will leave areas free for pocket parks, outdoor education centers, and other natural beautification centers.

Every school ground will become a place of beauty and present an inviting look that will enhance the beauty of each community.

Research will begin in developing types of grass that will be a source of beauty and not requiring much water.

A sufficient number of recreation areas will be developed, in each community, for the young as well as the elderly.

One day there will be no poverty areas in the city. Condemned homes will be replaced with more modern, up-to-date facilities.

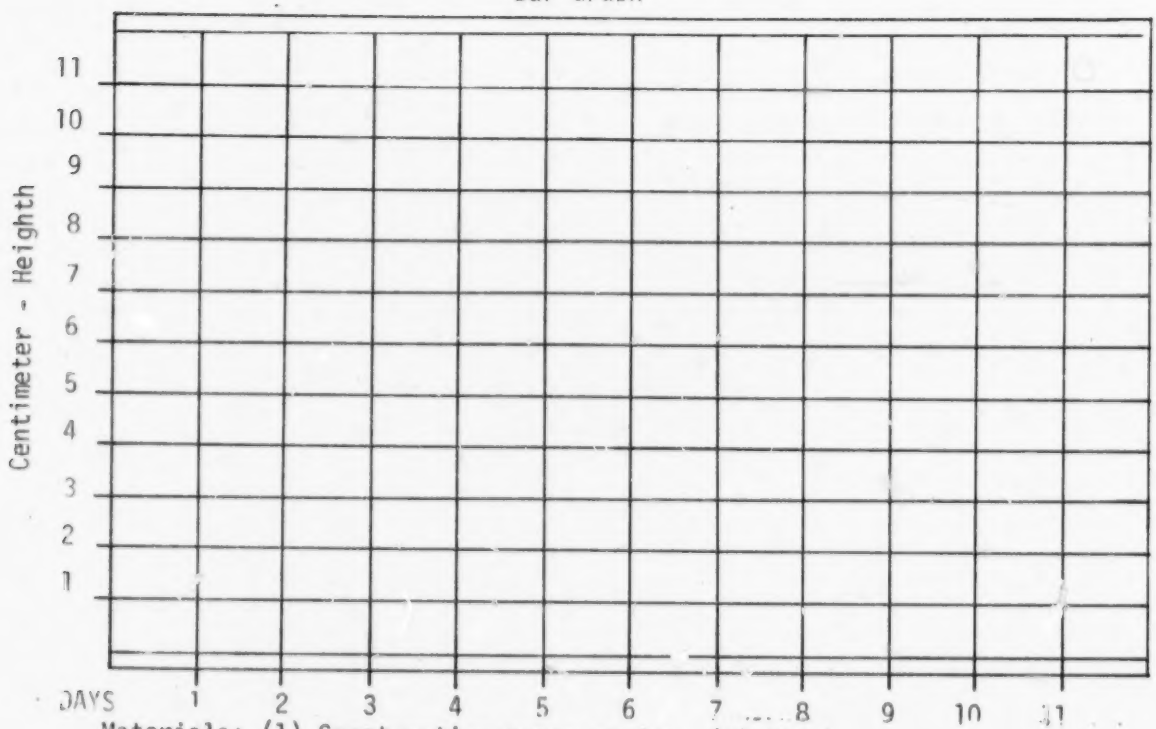
City, state, and national representatives will make a real effort to visit local communities and meet with local people concerning the needs of the community.

Each school will make a real effort to educate the children concerning the environment and how they can help to make their community the prettiest in the state.

APPENDIX

SEED GROWTH

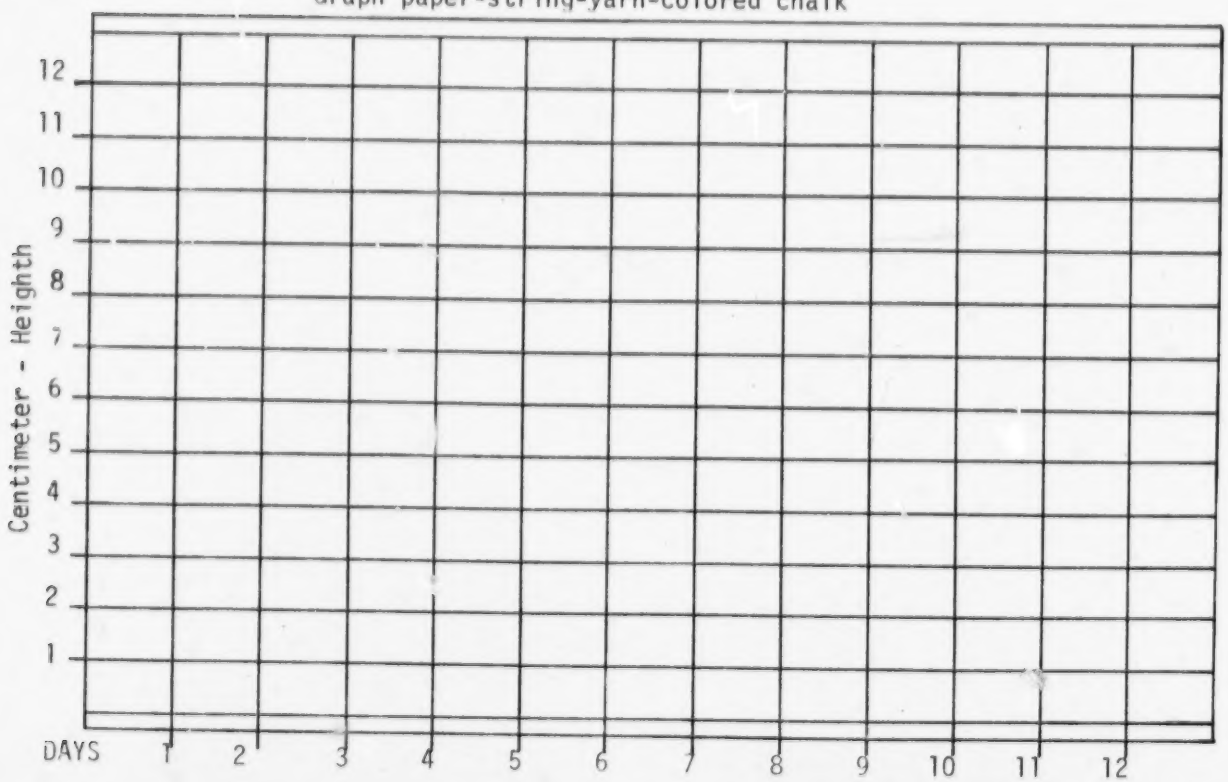
Bar Graph



Materials: (1) Construction paper strips
(2) String
(3) Yarn
(4) Sticks
(5) Tounge Depressers
(6) Draw on board using colored chalk

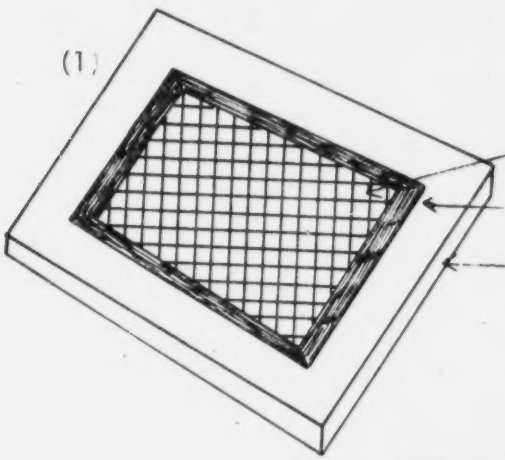
Line Graph

Graph paper-string-yarn-colored chalk



Construction Ideas for Miniature Environment

(1)



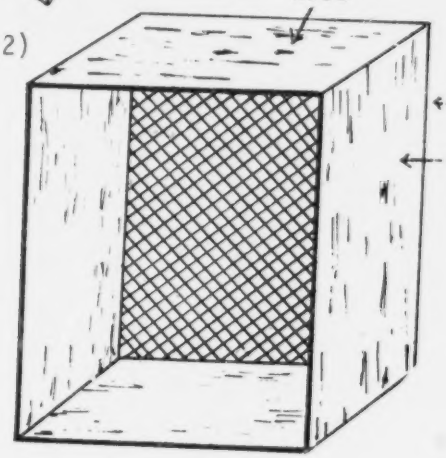
Wire mesh

Tape for holding wire mesh

Plexiglass
Plastic
Shoe box

Good for insects, spiders, etc.

(2)



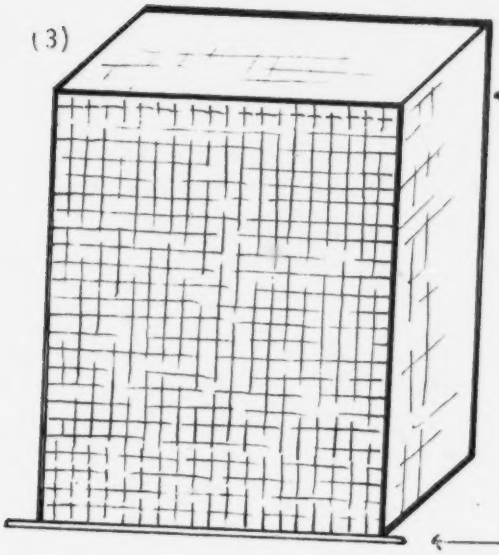
Wood

Back - wire mesh

Wood.

Front Plexiglass slides up and down.

(3)



Wooden dowels or other type of frame.

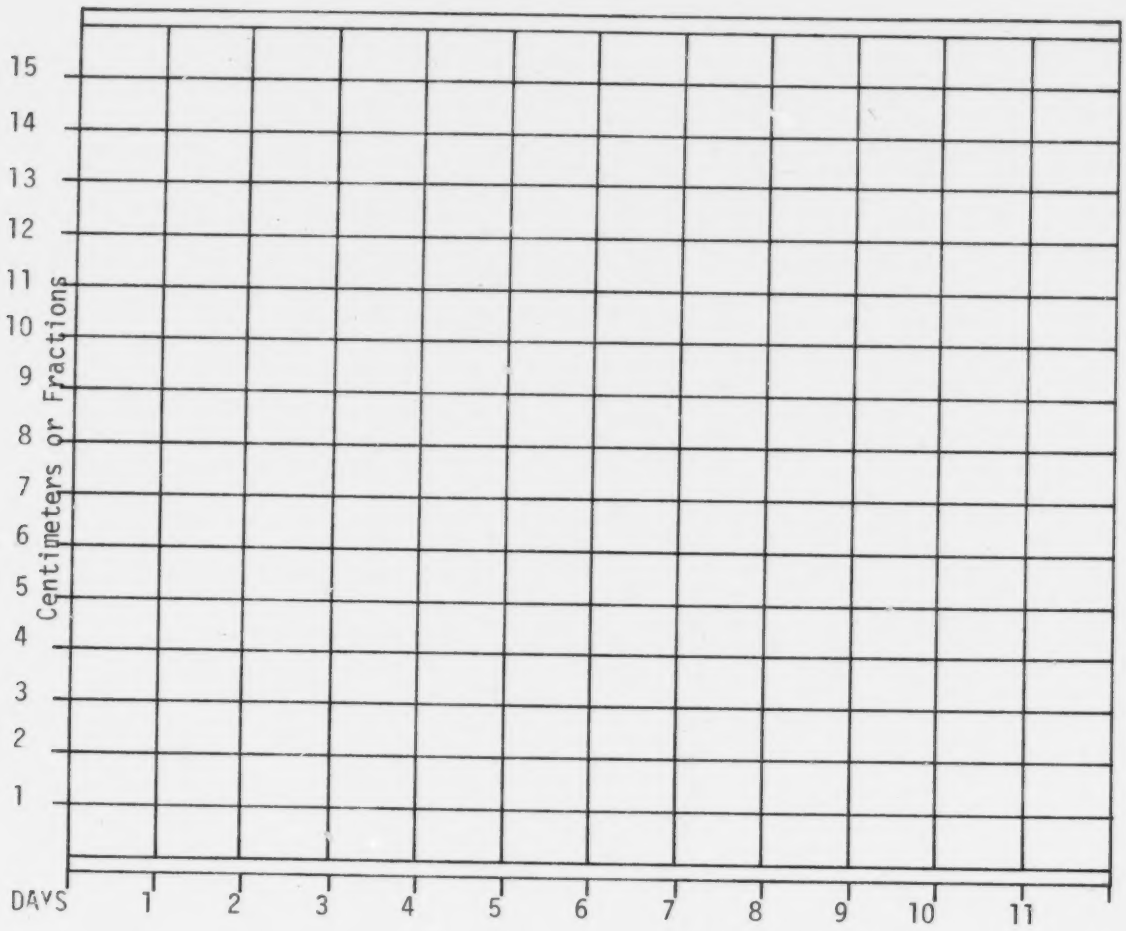
Any size is satisfactory depending upon needs.

Wire attached to rod - lift up for placement of insects.

EVAPORATION RATE
water and other liquids

LINE GRAPH

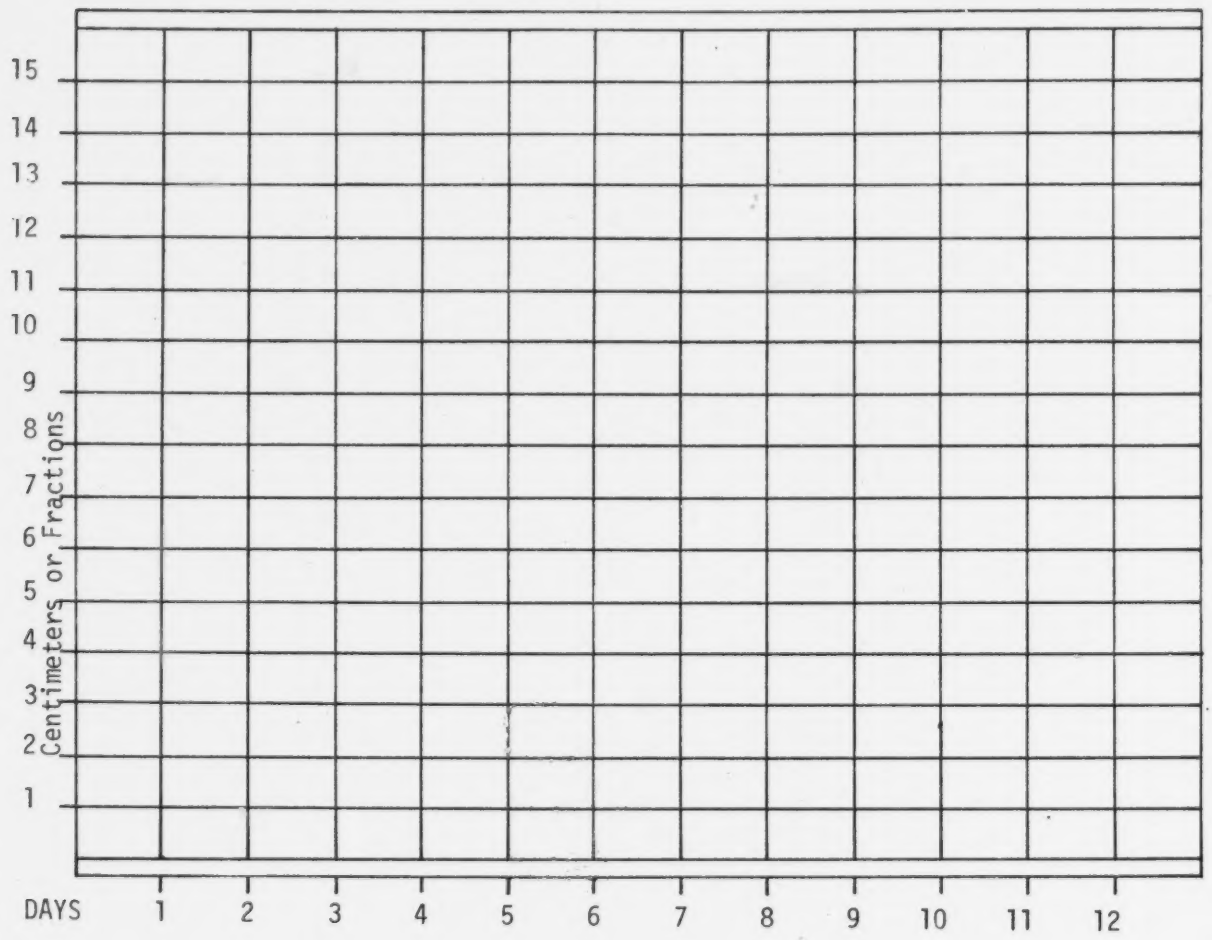
For making line use: string, yarn, chalk, crayola, pencil, pen etc.



EVAPORATION RATE
water and other liquids

BAR GRAPH

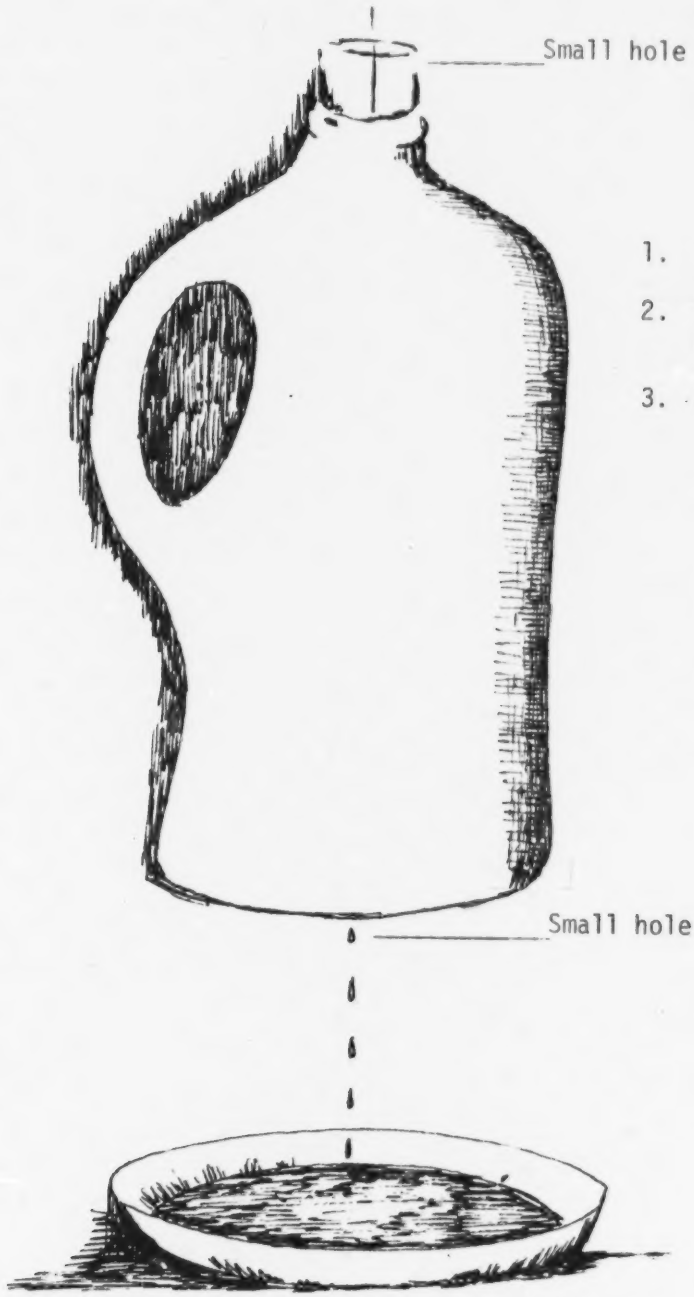
For making bars use: colored chalk, sticks, pencil, yarn etc.



DRIPPING RATE

Compare rate of liquids dripping

Equipment:
(1) Clorox bottle or other similar container.
(2) Metronome for checking count of drips per minute.
(3) Work in pairs - one watches second hand and the other counts and records.
(4) Compare metronome figures with a clock.



1. Try different kinds of liquids.
2. Will different kinds of liquid drip at the same rate? Why?
3. Study difference of thickness.

Aluminum pie pan or other container that creates sound.

CONDUCTION

Do water and other liquids conduct electricity?

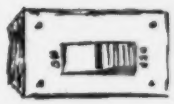
Equipment:

"D" cell
1 1/2 volts

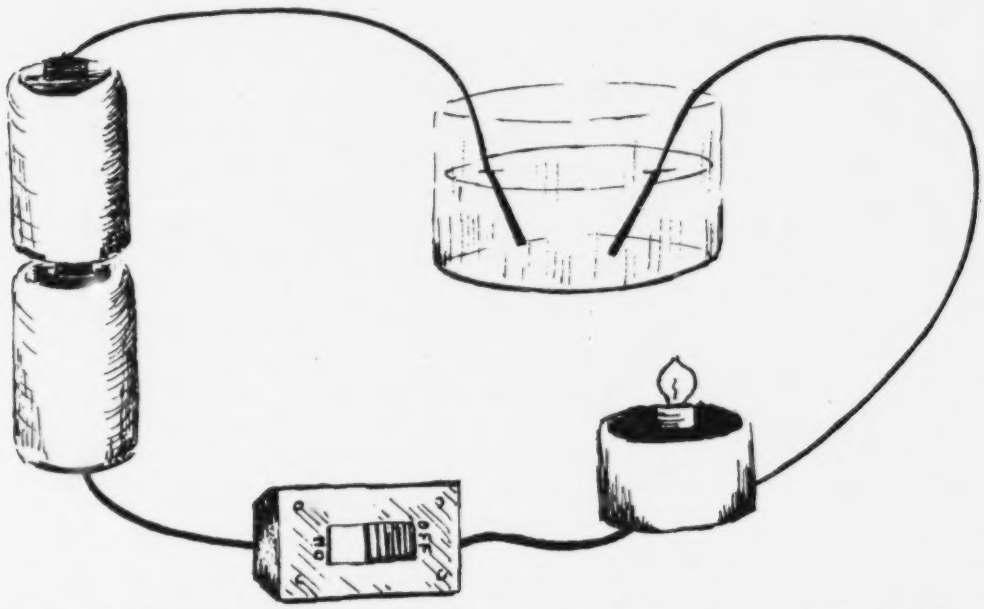
Wire

Socket-Bulb

Switch



Liquids of different kinds -



1. Use different numbers of "D" cells. Does it make a difference?
2. Use different kinds of bulbs. Will it matter?
3. Do not use more than 18 volts.
4. Try different kinds of liquids such as water, vinegar, oil, salt water, sugar water, etc.

HOW TO MAKE A PITFALL TRAP

Materials:

1. Wide-mouthed gallon jar
2. Shovel
3. Rock, wood, cardboard, metal, etc.

Procedure:

1. Select an area where you suspect there is an abundance of animals (lizards, snakes, insects, spiders, scorpions, etc.).
2. Dig a hole of sufficient width and depth to contain a wide-mouthed gallon jar.
3. Fill in soil around the jar so that the rim of the jar is even with the surface of the soil.
4. Place 3 small stones (one to two inches in height) around the rim of the jar.
5. Place a piece of wood, cardboard, metal or a rock on top of the 3 small rocks so that it covers the mouth of the jar.
6. Check your traps daily and record what you have trapped.
7. Check your traps in the morning and evening to become aware of differences in nocturnal and diurnal animals.
8. Use some of the animals for behavior studies or other experiments.

HOW TO MAKE A LIVE TRAP

LIST OF MATERIALS

MOUSE TRAP

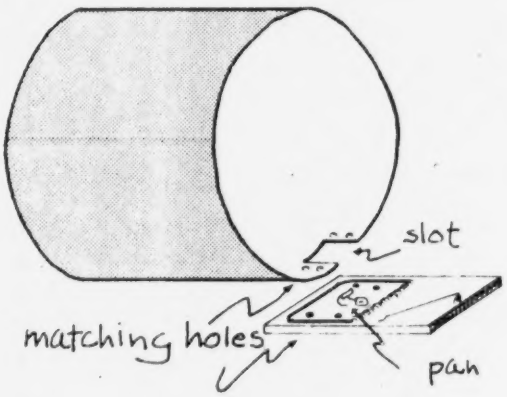
LARGE (2 lb. or more) COFFEE CAN

HARDWARE CLOTH (1/4" mesh) TO COVER CAN OPENING

8 INCH PIECE OF WIRE

ASSEMBLY

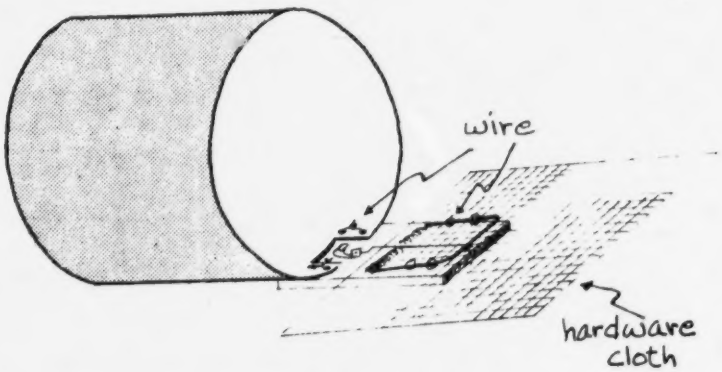
Cut slot in can rim just large enough for mouse trap pan



Drill or punch with nail, 4 holes around slot in can and 4 matching holes in mouse trap base.

Attach trap to can with wire through matching holes

Attach hardware cloth to mouse trap snapper with wire



LIVE TRAP IN SET POSITION

BEAUFORT SCALE OF WIND FORCE

Beaufort number	Specifications for use on land	Miles per hour (statute)	Terms used in U.S. Weather Bureau Forecasts
0.....	Calm; smoke rises vertically	Less than 1	Light
1.....	Direction of wind shown by smoke drift, but not by wind vanes.	1-3	
2.....	Wind felt on face; leaves rustle; ordinary vane moved by wind.	4-7	
3.....	Leaves and small twigs in constant motion; wind extends light flag.	8-12	Gentle
4.....	Raises dust and loose paper; small branches are moved.	13-18	Moderate
5.....	Small trees in leaf begin to sway; crested wavelets form on inland waters.	19-24	Fresh
6.....	Large branches in notion; whistling heard in telegraph wires; umbrellas used with difficulty.	25-31	Strong
7.....	Whole trees in motion; inconvenience felt in walking against wind.	32-38	
8.....	Breaks twigs off trees; generally impedes progress.	39-46	Gale
9.....	Slight structural damage occurs (chimney pots and slate removed).	47-54	
10.....	Seldom experienced inland; trees uprooted; considerable structural damage occurs.	55-63	Whole gale
11.....	Very rarely experienced; accompanied by widespread damage.	64-75	
12.....	.....	Above 75	Hurricane

Dissolved Oxygen Determination

Winkler Method

The first three steps described below must be performed in the field immediately after the sample has been secured. Extreme care must be used in collecting a sample of water for oxygen determination.

1. Remove stopper from a 300 ml. glass stoppered B.O.D. bottle, and collect the sample of water. By means of a volumetric pipet, add 2 ml. of manganous sulfate well below the surface of the water. In like manner, add 2 ml. of KOH-KI solution.

2. Replace stopper and mix sample by inverting bottle several times. Allow precipitate to settle for a few minutes. Thorough mixing is required.

3. By means of a volumetric pipet, add 2 ml. of concentrated sulfuric acid by permitting it to run down neck of bottle; mix well by inverting bottle several times. Allow sample to stand for at least 5 minutes.

4. Transfer the amount needed for titration. This should correspond to 200 ml. of original sample after corrections for the loss of sample by displacement with the reagents has been made. Thus when 4 ml. (2ml. each of the manganous sulfate and alkaline-iodine) of reagents is added to a 300 ml. bottle, the volume for titration should be:

$$200 \times \frac{300}{300-4} \text{ equals } 203 \text{ ml.}$$

5. Titrate rapidly with a N/40 sodium thiosulfate solution until color becomes a pale straw one. Next add 2 ml. of starch solution and continue rapidly but cautiously until blue color first disappears. Discontinue titration at this point. Ignore any return of blue color.

Calculation of Results

The number of ml. of the sodium thiosulfate solution used is numerically equal to the dissolved oxygen content in mg/l. This value, multiplied by 0.698 will yield the value in terms of cc. per liter. The percentage of saturation may be obtained from Rawson's nomogram.
(Welch, 1948: 366)

The unmodified Winkler method should be used only in unpolluted waters.

Preparation of Dissolved Oxygen Reagents

1. Reagents

Manganous Sulfate Solution:
Dissolve 480 g $MnSO_4$, 400 g $MnSO_4 \cdot 2H_2O$, or 364 g $MnSO_4 \cdot H_2O$ in distilled water, filter, and dilute to 1 liter. When uncertainty exists regarding the water of crystallization, a solution of equivalent strength may be obtained by adjusting the specific gravity of the solution to a value of 1.270 at 20°C. The manganous sulfate solution should liberate not more than a trace of iodine when added to an acidified solution of potassium iodide.

Alkali-iodide-azide reagent:
Dissolve 500 g NaOh or (700 g KOH) and 135 g NaI (or 150 g KI) in distilled water and dilute to 1 liter. To this solution add 10 g NaN_3, which is sodium ozide and is a high explosive dissolved in 40 ml distilled water. Potassium and sodium salts may be used interchangeabley. This reagent should not give a color with starch solution when diluted and acidified.

Sulfuric acid, conc.:
The strength of this acid is about 36N. Hence, 1 ml is equivalent to about 3 ml of the alkali-iodide-azide reagent.

Starch solution:
Prepare an emulsion of 5-6 g potato, arrowroot, or soluble starch in a mortar or beaker with a small quantity of distilled water. Pour this emulsion into 1 liter if boiling water, allow to boil a few minutes, and let settle overnight. Use the clear supernatant. This solution may be preserved with 1.25 g salicylic acid per liter or by the addition of a few drops of toluene.

Sodium Thiosulfate stock solution, 0.10N.:
Dissolve 24.82 g $Na_2S_2O_3 \cdot 5H_2O$ in boiled and cooled distilled water and dilute to 1 liter. Preserve by adding 5 ml chloroform or 1 g NaOH per liter.

Standard sodium thiosulfate solution, 0.025N.:
Prepare either by diluting 250.0 ml sodium thiosulfate stock solution to 1,000 ml, or else by dissolving 6.205 g $Na_2S_2O_3 \cdot 5H_2O$ in freshly boiled and colled distilled water and diluting to 1,000 ml. Standard sodium thiosulfate solution may be preserved by adding 5 ml chloroform or 0.4 g NaOh per liter. Standard sodium thiosulfate solution, exactly 0.0250N, is equivalent to 0.200 mg DO per 1.00ml.

Standarize with (a) biniodate or (b) dichromate:

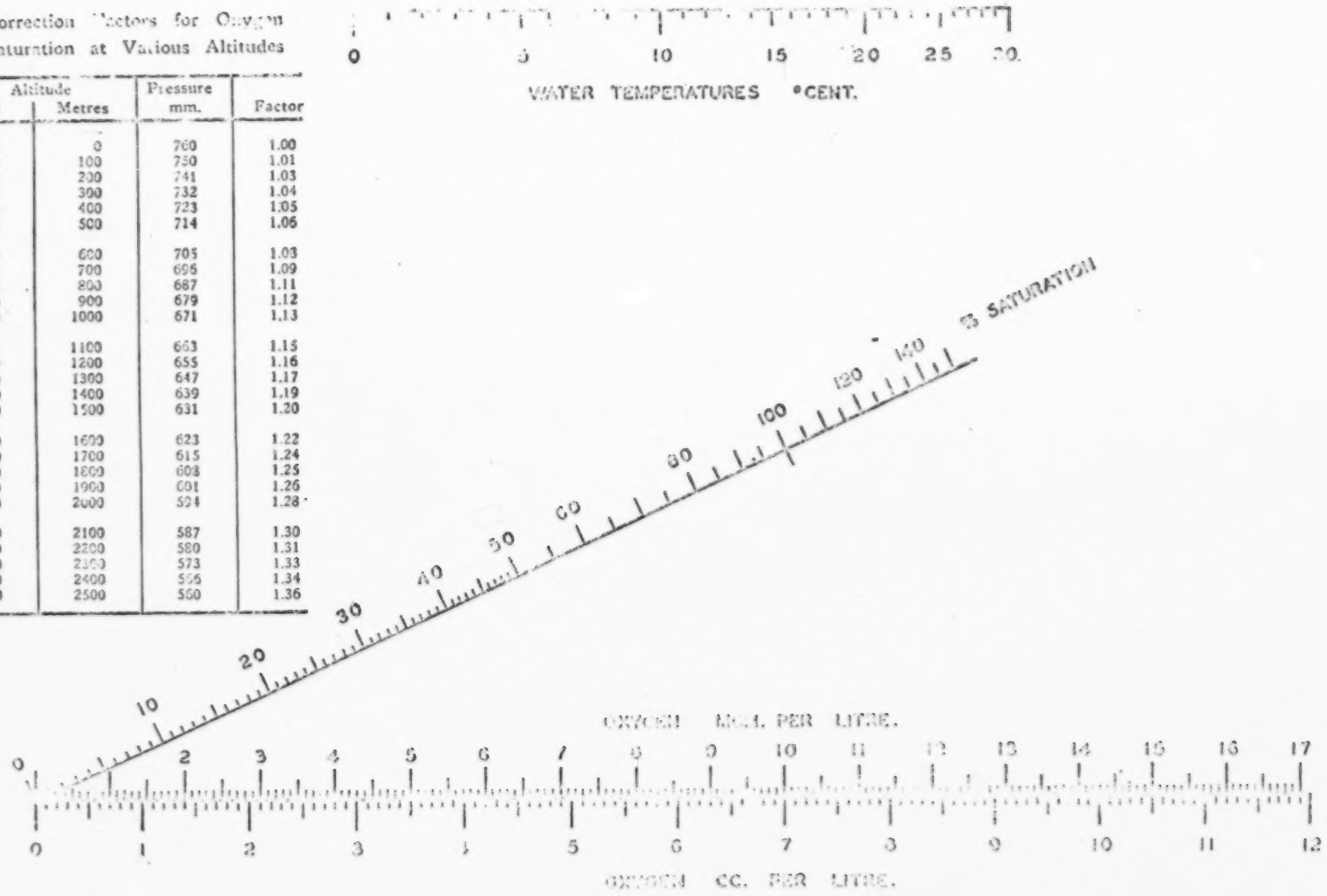
(a) Standard potassium biniodate solution, 0.025N.

A stock solution equivalent in strength to 0.1N thisulfate solution contains 3.249 g/l $KH(IO_3)_2$. The biniodate solution equivalent to the 0.025N thiosulfate contains 0.8124 g/l $KH(IO_3)_2$., and may be prepared by diluting 250 ml stock solution to 1 liter in a volumetric flask.

Nomogram for obtaining oxygen saturation values.

Correction Factors for Oxygen Saturation at Various Altitudes

Altitude Feet	Altitude Metres	Pressure mm.	Factor
0	0	760	1.00
330	100	750	1.01
655	200	741	1.03
980	300	732	1.04
1310	400	723	1.05
1640	500	714	1.06
1970	600	705	1.08
2300	700	695	1.09
2630	800	687	1.11
2950	900	679	1.12
3280	1000	671	1.13
3610	1100	663	1.15
3940	1200	655	1.16
4270	1300	647	1.17
4600	1400	639	1.19
4930	1500	631	1.20
5250	1600	623	1.22
5580	1700	615	1.24
5910	1800	608	1.25
6240	1900	601	1.26
6560	2000	594	1.28
6900	2100	587	1.30
7220	2200	580	1.31
7550	2300	573	1.33
7880	2400	566	1.34
8200	2500	560	1.36



Wattage Per Hour As Compared To The Cost Per Hour

Appliance	Cost	Wattage
Air conditioner (window)	3.7 cents	1,257
Bed covering	.33	117
Broiler	3.1	1,008
Carving knife	.78	266
Clock	.02	2
Clothes dryer	14.55	4,856
Coffee maker	2.6	894
Dehumidifier	.75	257
Dishwasher	3.6	1,201
Fan (furnace)	.87	292
Fan (window)	.6	200
Food blender	1.4	386
Food freezer (15 cu. ft.)	1.02	341
Food freezer (frostless 15 cu. ft.)	1.32	440
Food mixer	.36	127
Food waste disposer	1.32	445
Frying pan	3.57	1,196
Grill (sandwich)	3.48	1,161
Hair dryer	1.14	381
Heat pump	35.52	11,848
Heater (radiant)	3.96	1,322
Heating pad	.18	65
Hot plate	3.75	1,257
Humidifier	.33	117
Iron (hand)	3.24	1,088
Oil burner or stoker	.78	266
Radio	.21	71
Radio-phonograph	.30	109
Range	36.60	12,207
Refrigerator (12 cu. ft.)	.72	241
Refrigerator (frostless 12 cu. ft.)	.96	321
Refrigerator (freezer-14 cu. ft.)	.97	326
Refrigerator-freezer (frostless 14 cu. ft.)	1.83	615
Roaster	3.99	1,333
Sewing machine	.21	75

Shaver	.03	14
Sun lamp	.81	279
Television (B&W)	.69	237
Television (color)	.99	332
Toaster	3.34	1,146
Tooth brush	.02	7
Vacuum cleaner	1.89	630
Waffle iron	3.33	1,116
Washing machine (automatic)	1.53	512
Washing machine (non-automatic)	.84	286
Water heater (standard)	7.41	2,475
Water heater (quick recovery)	13.41	4,474
Water pump	1.38	460

GUIDELINES FOR ENVIRONMENTAL ACTION

Environmental action begins with me. My world is here and now. When I change myself, my world begins to change.

A positive approach in bringing about environmental change with an emphasis on maintaining, restoring and improving environmental quality is most effective in my experience. Many environmental programs have failed to materialize, but not because they were strongly opposed, but simply because no one promoted them.

I suggest several action steps and alternatives to you which have proven to be effective for me and those with whom I am associated. I believe the guidelines will improve your chances of being successful change agents in a culture which, in my opinion, is badly in need of change.

A. Personal awareness:

1. Get in touch with your environment (see "environmental awareness experiences").
2. What are your feelings about your environment?
    a. What parts of your environment are affecting you positively?
    b. What parts of your environment are affecting you negatively?
    d. What parts of your environment are not affecting you at all?
3. Is your life style and that of others around you getting you the results you want? Are you happy? Is there joy in your life?
    a. What attitudes and values must you seek to change in order to get a different result(s)?
    b. What parts of your environment, which are affecting you negatively or not affecting you at all, would you like to change?
4. Make a list of the environmental changes you would like to see made.
    a. Restructure the list according to priorities assigned to the desired changes in terms of their relevance to you.
    b. State your top priority desired change as a problem to be solved.

B. Define your chosen environmental problem:

1. Use reference materials - books, reports, journals, etc.
2. Use resource persons - teachers, scientists, etc.

C. Assess the local extent or severity of your chosen environmental problem:

1. Consult reports and data of local and state agencies.
2. Attending meetings and hearings is important.
3. Do your own original research on environmental problems "Nader's Raiders Approach."

D. Make recommendations which will lead toward a solution to your chosen environmental problem:

1. Use reference materials and resource persons again.
2. Obtain information and materials from other communities which have faced and solved problems similar to yours.
3. Create your own plans and designs.

D. Develop plans to act on your recommendations:

1. Join or create a local conservation organization (preferably one which has affiliation with state, regional and national conservation organizations).
2. Set your goals and don't lose sight of them.
    a. Know what kind of action you want.
    b. Develop your plan for action.
        1. Educate each other.
        2. Organize events and sequence of events.
        3. Determine the individual responsibility of the persons to be involved.
        4. Hold "check-point" meetings to keep everyone knowledgeable of what progress has been made.
3. Get involved in the community:
    a. Know the existing laws and ordinances related to the environment.
    b. Know the local zoning laws.
    c. Know the local, state and national legislation that is currently pending.
    d. Be alert to plans of developers and other special interest groups.
    e. Obtain schedules of hearings which deal with environmental matters; attend and testify.
    f. Discover who your friends and enemies in the community are.
    g. Develop a "speaker's bureau."
    h. Seek publicity - local media and your own newsletter.
    i. Know the voting records of the local governmental officials and be sure they know you know.
    j. Develop a rapid feedback system - positive and negative feedback.
    k. Develop a list of experts and consultants-lawyers, scientists, physicians, etc.
    l. Form coalitions with other local conservation or empathetic groups.

m. Keep accurate files up-to-date and readily available.
n. Write letters - individual and joint.
o. Develop a telephoning system.
p. Petition local governmental agencies.
q. Use referendun if your efforts have failed and a damaging law has been passed or unsound variance given.
r. Use the courts of law. See to it that good laws are enforced and strengthened. Seek injunctions to halt environmental damage and to buy time for your action program. File suits.
s. Use peaceful demonstrations to create awareness in others.
t. Use economic boycott-against the unresponsive.

RESOURCES AND REFERENCES

RESOURCES

Check with your local and State Beautiful Associations for lists of films, filmstrips, and a list of names of individuals, who have real skills in the area of beautification and outdoor education.

Many fine field trips can enhance the value of the environment. Possible suggestions:

1. Local nurseries for ideas about plants, and flowers that will grow in your center.
2. Water treatment and sewage treatment plants.
3. Local large businesses that have pollution problems and obtain variances for continuation of problems.
4. Visit the weather bureau.
5. Tour neighborhoods, from total community, for discussion of differences.
6. Visit local high school and college science laboratories for comparison of scientific equipment and how it is used for pollution control and study.
7. Visit rock displays, rock shops, or displays at local schools.
8. Visit with local soil conservationists and observe soil testing experiments.
9. Visit local recreational sites to determine weaknesses and strengths: fishing lakes, parks, wildlife habitats, and water sources.
10. Visit other outdoor educational areas for ideas that might be incorporated into your own.
11. Go on clean-up campaigns.

Invite guest speakers into the classroom for additional thinking and ideas concerning environmental problems, your outdoor center, people with expertise in the area of Geology, Botany, Bacteriology, Conservation of our Natural Resources, and others that will add enrichment of the activities.

CIVIC GROUPS THAT MIGHT BE HELPFUL

1. Girl Scout Council, Columbine Office, 322 W. 5th
2. Handicap Club, Pueblo
3. Rockhounds Club, Inc., Pueblo
4. Boy Scouts of America

Check with the Pueblo Chamber of Commerce for information concerning offices and their addresses.

U.S. Government -

1. Forest Service - 910 W. Highway 50 - 544-5277
2. Soil Conservation Service - Federal Building - 544-5277
3. Interior Department of Bureau of Sport Fisheries and Wildlife - Colorado Building - 543-2286
4. Geological Survey - Water Resource Division - 1st National Bank Building - 544-5277
5. Environmental Science Services and Weather Bureau - Pueblo Memorial Airport - 948-3371
6. Bureau of Reclamation - 1st National Bank Building - 544-5277

Pueblo -

1. Parks and Recreation - City Park - 542-1745
2. Greenhouse - Mineral Palace Park - 544-8392

Pueblo County Government

1. CSU Co-Operative Extension Service - 543-3550

Colorado State Government

Game Fish and Parks Department - Regional Office, 2126 N. Weber, Colorado Springs - 545-2216

Pueblo Beautiful Association

Colorado Beautiful Association

Recommended Plant Materials For Pueblo

AREA		SPECIES				FORMS OF PLANTING STOCK AVAILABLE			LOCAL PLANTING AND OTHER INFORMATION		
Name	No.	Trees	Shrub or Shrub-like	Grasses	Forbs	Buy Seed	Native Trans-Plant	Buy live commer-cially	Exposure	Colors Summer & Fall-Winter*	Geology & Soils
Mountain	1	Blue Spruce					X	X	Open	Blueish green	Granite, etc.
	2	Limber Pine					X		Some shade desirable	Dark green	
	3	White Fir					X		Dense shade	Blueish green	
	4	Aspen**					X		Dense shade	Green-mixed colors in fall	
	5	Ponderosa					X	X	Open	Dark green	
	6		Kinnikinnick				X		Shade	Light medium green	Mountain soil top layer, local loam
	7		Oregon Grape				X	X	Shade	Green-reddish or purple*	
	8		Common, low Juniper				X	X	Open	Dark Green	soil for base of fill
	9			Fescues			X	X	E to NE slope	Green-Tan*	
	9			Mtn. Muhly			X		E to NE slope	Green-Tan*	
	9			Mtn. Brome			X		Shade	Green-Reddish*	
	10				Columbine			X	Dense Shade	Green-Blueish to purplish Flowers	
	11										
	11										
					Indian Paint-Brush		X		Open	Yellow to red-dish flowers	
	12		Snowberry				X		Open	Light green & yellowish*	
	13		Mtn. Mahogany			Collect Native	X		NE-E slope	Green	
	14		Fringe Sage				X		E-SE slope	Gray	
	15		Shrubby Cinquefoil				X		E-SE slope	Green-yellow flowers	

**Unusual difficulty may be experienced in transplanting and establishing plants.

Recommended Plant Materials For Pueblo

AREA	SPECIES					FORMS OF PLANTING STOCK AVAILABLE			LOCAL PLANTING AND OTHER INFORMATION		
Name	No.	Trees	Shrub or Shrub-like	Grasses	Forbs	Buy Seed	Native trans-plant	Buy live commer-cially	Exposure	Colors Summer & Fall-Winter*	Geology & Soils
River Bottom	16			Salt Grass			X		Open	Green-Yellow-ish*	Mixed clays-silts, sands, gravels and small rocks
	17				Cattail		X		Open	Green	
	18		Willow				X		Open	Yellowish green	
	19		Salt Cedar				X		Open	Reddish bark & green leaves	
"Temperate" or foothills	20	One-seed Juniper					X	X	Open	Green	Local loam soil and sandstone
	21	Rocky Mtn. Juniper					X	X	Open	Grayish green	
	22	Pinon					X	X	Open	Dark green	
	23		**Gamble Oak				X		N slope	Green & reddish brown*	
	24		Skunkbush				X	CSU	Open	Green-reddish berry	
	25			Western Wheat		X	X		Open	Bluegreen	
	26			Blue grama		X	X		Open	Green & yellow-ish*	
	27			Indian Rice		X	X		Open	Green	
	28			Needle & Thread			X		N slope	Green	
	29			Sideoats grama		X	X		Open	Green & reddish	
	30			Little bluestem		X	X		Open	Green & reddish	

**Unusual difficulty may be experienced in transplanting and establishing plants.

Recommended Plant Materials For Pueblo

AREA		SPECIES				FORMS OF PLANTING STOCK AVAILABLE			LOCAL PLANTING AND OTHER INFORMATION		
Name	No.	Trees	Shrub or Shrub-like	Grasses	Forbs	Buy Seed	Native trans-plant	Buy live commer-ically	Exposure	Colors Summer & Fall-Winter*	Geology & Soils
Semiarid	31		Fourwing Saltbush				X		Open	Gray	Local Loam and Limestone
	32		Bigelow sage				X		Open	Gray	
	33		Cholla Cactus				X		Open	Green with pink flowers	
	34		Prickly Pear				X	X	Open	Green with pink or yellow flowers	
	35			Galleta			X		Open	Green & Yellow-ish*	Local shale Derived soil and shale
	36			Alkali Sacaton			X		Open	Green	
	37		Shadscale				X		Open	Gray	
	38		Low Rabbit-brush				X		Open	Grayish green with yellow flowers	
	39		Yucca				X	X	Open	Green	
	40		Sand sage				X		Open	Gray	
	41			Sand reed				X	Open	Green	sandy soil
	42			Sand blue			X	X	Open	Blueish green	
	43			Switch grass			X	X	Open	Green	
	44			Big Bluestem			X	X	Open	Green & reddish*	

Whole Works

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